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Provision of Airports to Isolated Communities: Technical Memorandum

Prepared for
Transportation
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by
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Canada

The contents of this report reflect the views of the authors and not necessarily the official views or policies of the Transportation Development Centre of Transport Canada.

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17 Abstract

This Technical Memorandum provides supporting detailed analysis and background information to the Main Report (TP 7416E).

The report presents the design of a reduced-cost, adequately safe, minimum standard airport for remote communities. Its cost is approximately one-half that using conventional designs. It is designed to serve communities too small to warrant service by aircraft larger than light twins under day/night visual meteorological conditions. Features of the design include: a standard runway of 366 m length by 15 m width, seven alternative pavement sections, access road of one lane width, ATCO type trailer as a terminal building, extensive communication and visual landing aid facilities, plus a low-powered non-directional beacon.

The costs of providing such airports to remote communities, and the benefits from improved air access, in particular emergency evacuation, have been evaluated.

In the pilot province (Manitoba) there are twelve sites ranging in size from 90 to over 1000 population that would benefit from construction of new airports. In all the provinces there is an estimated total of 135 sites. Applying standardized costs, based on Winnipeg prices, the 135 airports would cost $153.3 million and produce incremental benefits of $295 million (present value over 20 years - 1985-$).

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17. Résumé

Cette annexe technique apporte une analyse détaillée et de l'information complémentaire au rapport principal (TP7416E). Le rapport traite de l'étude d'un aérodrome répondant aux normes minimums, raisonnablement sûr, coûtant moins cher à construire et devant desservir les villages isolés du Canada. Il reviendrait environ deux fois moins cher qu'un aérodrome classique. On vise de la sorte à desservir les petites agglomérations dont la population est trop faible pour justifier un service par des avions autres que des bimoteurs légers, volant de jour ou de nuit dans des conditions météorologiques de vol à vue. L'aérodrome proposé a les caractéristiques suivantes: une piste de 366 m sur 15 m, une chaussée aéronautique construite d'après l'une des sept options proposées, une desserte routière à une voie, une remorque ATCO servant de bâtiment d'accueil permanent, des aides complètes à la navigation et à l'atterrissage à vue ainsi qu'une balise omnidirectionnelle de faible puissance.

Le rapport présente le coût estimatif pour la construction d'aérodromes du type proposé ainsi que les avantages d'une desserte aérienne aéliorée, notamment les services d'évacuation d'urgence qu'elle autorise. Au Manitoba, qui est la région pilote pour la recherche, on dénombre 12 villages isolés dont la population varie de 90 à 1 000 âmes et dont le sort pourrait être grandement amélioré par l'implantation d'un aérodrome du type proposé. A l'échelle du Canada, on dénombre 135 villages isolés. Utilisant des coûts normalisés, en vigueur à Winnipeg, la construction de 135 aérodromes pour ces villages coûterait 153,3 millions, mais apporterait des avantages financiers supplémentaires de 295 millions de dollars de 1985, actualisés sur une base de 20 ans.

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1.0 INTRODUCTION

1.1 Background

This project had its genesis as a proposal in 1982, culminating in a Supply and Services Canada contract on September 10, 1984. Because the project's purpose is to improve air access to remote communities, it has drawn support from Transport Canada and the Province of Manitoba (Transportation Division).

The objective of the project is to develop guidelines for the location, planning, design, construction, operation and maintenance of airports for isolated communities. By focusing on airport cost reduction within acceptable levels of safety, the project's guidelines may lead to increased accessibility to isolated communities.

1.2 Project Overview

The project contains three phases. Phase 1 determined the scope of remote airport needs and presented a preliminary justification for a remote airports program. The Phase 1 Report was submitted in November, 1984. Phase 2 contained analyses of: alternative airport design, operation and maintenance; safety; and socio-economic benefits. The output of Phase 2 fed into a refined engineering and cost/benefit analysis in Phase 3 to define the optimum remote airport guidelines. Phase 3 also examined legal and jurisdictional issues involved in developing an implementation plan for improved air access to Canada's isolated communities.

1.3 Scope and Objectives

The project is Provincial in scope. The objectives are:

(i) to develop a reduced-cost minimum standard airport design for remote communities, within adequate safety limits, and

(ii) to estimate the financial implications of implementing a nation-wide program of construction of new airports developed to the recommended guidelines.

1.4 Report Organization

This Technical Memorandum provides supporting detailed analysis and background information to the Main Report (TP 7416E). This report is organized in Chapters. The first Chapter contains introductory material. Chapter 2.0 describes the rationale for choosing Manitoba as a pilot province for this study. Airport component alternatives (runway length, width, surface types etc.) are presented in Chapter 3.0. Aircraft cost/performance profiles follow in Chapter 4.0. Airport components are matched to aircraft requirements to produce three levels of airport facilities in Chapter 5.0. The following Chapter 6.0 examines airport related aircraft accident probabilities. Air travel demand for typical remote communities, and associated socio-economic benefits realized from the provision of air services to satisfy the demand, are detailed in Chapter 7.0. In Chapter 8.0, the accident probabilities of Chapter 6.0 are combined with the air travel demand of Chapter 7.0 to develop expected accident figures for each of the three airport facility alternatives. A set of criteria are developed (costs, benefits, safety, feasibility) to select the best airport alternative in Chapter 9.0.

2.0 METHODOLOGY FOR DETERMINING THE SCOPE OF REMOTE AIRPORT NEEDS

2.1 Use of Manitoba as a Pilot Region

To reduce the amount of analysis required for this study, Manitoba was selected as a pilot region in which to carry out an in-depth analysis. Preliminary contacts with officials from Manitoba indicated that extensive studies had been conducted on Manitoba's remote airports and that Manitoba would be willing to participate. Based on the CTC Isolated Communities Digest of Social and Economic Data(1), Manitoba's isolated communities represent a little over a 10% sampling of such communities across the country. In this sample there is a variety of circumstances representative of communities across the nation. In-depth research on this sample was applicable to other provinces and was expanded to attain an approximation of the scope of remote airport needs in the rest of the provinces, in Phase 1 of the study.

2.2 Identification of Remote Communities in Manitoba

Candidate remote communities in Manitoba were identified using a minimum population criterion of 50 persons. The Statistics Canada, Place Name Reference List for the Western Provinces and the Territories(2) was used to determine which communities qualified under this criterion. Based on inspection, it was assumed that communities south of latitude 51 degrees could be eliminated from the anlaysis. Subsequent communication(3) has suggested a modified southern boundary based on Census Division boundaries. Adoption of this boundary would not change the results of the Phase 1 analysis.

Inadequate emergency access to a hospital possessing operating facilities was considered a key factor in identifying communities that could benefit from the provision of upgrading of an airport. Road and air travel times were compared with emergency trip time criteria (4 hours from report of accident to delivery of casualty to hospital), to establish which remote communities required air medical evacuation service. These communities, identified in Phase 1, were used in Phase 2 to determine direct operating costs for provision of emergency air service, and socio-economic benefits resulting from that service. A recent study(4) has shown that mortality rates caused by emergency medical trauma are significantly reduced as access time to hospitals is reduced.

References to Chapter 2.0

1. Isolated Communities of Transportation Social and Economic Data, Canadian Transport Commission Research Branch, No. 10-77-5, Ottawa, June 1977.

2. Place Name Reference List, Western Provinces and the Territories, Statstics Canada, No. E-484, Ottawa, May 1983.

3. Letter from J. Craven, Manager, Transportation Research Transportation Policy, Program & Research Division, Manitoba Dept. of Highways and Transportation, Winnipeg, Manitoba, Feb. 11, 1985.

4. "Trauma", Scientific American, Volume 249, No. 2, pp 33, 34, August 1983, by D. Trunkey.

3.0 AIRPORT COMPONENT ALTERNATIVES

3.1 Approach to Design of Remote Airports

This section describes the approach to and design of a minimal level of service airport that can be constructed at the lowest possible cost. The role of this airport is to provide limited commercial air service and emergency air service to communities too small to justify the cost of constructing a normal airport. For the northern Manitoba region, the more conventional airports cost in the neighborhood of $1.5 M each. By developing less expensive airports costing between one-third and one-half the cost for the conventional design, it should be feasible to provide, albeit at a lower level of service, air transport to these small remote communities. Due to the rather remote locations, the design focuses on providing the minimum runway area considered adequately safe to be used by experienced operators. Complementing this minimal runway are the provision of extensive navigational aids, including the provision of a low-powered non-directional beacon (NDB) at each airport. While the design is based on operation under visual meteorological conditions (VMC), an NDB has been provided because of the difficulty in locating small communities in remote areas having no distinctive physical geographical features, especially in the winter time.

A modular approach has been taken to developing descriptions of the various components. These components are divided into:

- civil works: access road, car park, aircraft apron, taxiway, runway and runway strip
- air terminal building and utilities: air terminal building, water supply, sewage, electrical power and heat
- lighting and navigational aids which include: apron, taxiway and runway lights, runway end identification lights; low intensity approach lights; PAPI; lighted wind sock; airport rotating beacon; and a non-Transport Canada approved low-powered beacon NDB.

Except for the pavements, the sub-components are standardized for all alternative airport designs. Many of these items are manufactured and will be imported to the site regardless of location. For the pavement types, seven alternatives are presented in terms of description of: pavement section; application to specific site conditions; unit costs; methods of construction; i.e. by imported contractors, or primarily local community self help; accessibility of construction supplies; and finally availability of local construction materials. The pavement section types range from those involving the maximum importation of highly processed materials to the maximum use of local resources and persons. Equipment requirements range from the normal heavy construction equipment to those often available within a small community.

For purposes of evaluation, alternative airport designs are developed for three typical aircraft types. These are: the Cessna Citation II; the Cessna 185; and the DeHavilland Twin Otter DHC-6-300 (operating in both the conventional and STOL modes). Thus in total there are four aircraft configurations for which the runways are designed. In determining the runway lengths required for these various aircraft, the gross takeoff weight of these aircraft were calculated as the takeoff weight at the remote site for the farthest emergency trip. In every case these designed gross takeoff weights were somewhat less than the maximum allowable weights for each of the aircraft. For example, the DHC-6 has a permissible gross takeoff weight of 5,682 kg (12,500) lbs. For the maximum distance emergency mission the design gross takeoff weight from the remote airport was reduced to 4,545 kg (10,000 lbs.).

3.1.1 Design Criteria

The primary references for the new design criteria are:

(a) Transport Canada's Aerdrome Standards and Recommended Practices, TP 312E Second Edition, August 1984(1) and the three Aircraft Manufacturer's Operational Manuals.(2,3,4)

Several deviations were made from the TP 312E standards in those areas which would result in reduced costs without reducing safety in any identifiable way, and keeping in mind that the airports are to be used by experienced aircraft operators.

Runway length determination for the Cessna 185 and DHC-6, both under 5,682 kg (12,500 lbs.), are based upon the takeoff distance to a 15 m (50 ft.) height. For the Cessna Citation II, while the takeoff weight at the remote site is only 5,000 kg (11,000 lbs.) the aircraft has a registered gross takeoff weight of 6,045 kg (13,300 lbs.) and hence the runway length requirement is based upon its one-engine out performance to a 10.7 m (35 ft.) height case, albeit at the 5,000 kg (11,000 lb.) gross weight. It may be acceptable to base the takeoff length on the distance to 15 m (50 ft.) height as for the non-performance aircraft using the lower takeoff weight. In this latter case the runway requirements will be reduced significantly.

The Aerodrome Reference Code for the Cessna 185 and the DHC-6 is classified as 1-A. Strictly applying Transport Canada criteria, the DHC-6 falls into the classification 1-B based upon its wing span exceeding 15 m (49 ft.). Applying only its main gear wheel span of 3.81 m (12.5 ft.) it then falls into category 1-A. Considerable cost savings occur for a 1-A over a 1-B category, (15 m width rather than 18 m). For the Citation II, the wing span and main gear wheel span both require an Aerodrome Reference Code number of 1-B.

Airplane Reference Field Length is defined in the Transport Canada Manual as the minimum field length required for takeoff at gross takeoff weight at 15° C, 0 height above sea level, 0 slope on the runway and 0 wind, as per the aircraft manufacturer's flight manual. These lengths are for a paved runway and correction factors are made for gravel and turf, again, in accordance with manufacturer's recommendations. The significant deviation made for this study, is that the maximum gross takeoff weight has been replaced by the mission oriented takeoff weight from the remote airport. Further, in the alternatives the runway length has been corrected to average critical conditions in northern Manitoba. Hence adjustments are made for: the temperature (using Transport Canada's Aerdrome Reference Temperature for Thompson, Manitoba, which is 21.9° C, rounded upwards to 22° C and an arbitrary elevation of 305 m (1,000 ft.) above sea level. Much of the terrain in the Manitoba area examined falls between 215 m (700 ft.) and 275 m (900 ft.) above sea level.

Cross Wind Component (reference section 3.3.1 b)(1) for under 1,800 kg aircraft is 19 kmh (10 knots) (Cessna 185). It is 28 kmh (15 knots) for turboprop airplanes over 1,800 kg (DHC-6) and 37 kmh (20 knots) for jet powered airplanes (Cessna Citation II).

Runway Width (reference section 4.3.1),(1) Aerodrome Reference Code 1-A for (Cessna 185, DHC-6) is 15 m width (modified) and for Citation II reference Code 1B is 18 m.

Runway strip (reference section 9.4.1)(1) length beyond runway pavement is 30 m and (reference 9.6.1 C), width either side of centreline is 30 m for Code 1.

Graded areas non-instrument runway (reference section 10.3.1)(1) width either side of centreline, 19 m for Code 1 (reference section 10.5.3.1)(1) transverse slopes, first three metres beyond edge of pavement equal to or less than 5% downwards, the balance equal to or less than 3%.

We propose to modify the transverse slopes beyond the initial 3 m to allow up to a 10% slope in fill areas where this would result in significant cost savings. For the types of aircraft using the runways, this 10% slope is considered to present no significant hazard.

Taxiways (reference section 13.2.1)(1) for Code A (Cessna 185 and DHC-6) 7.5 m (25 ft. minimum) and Code B (Citation II) 10.5 m (35 ft.) minimum.

Taxiway clearance (reference section 13.3)(1) centreline to centreline distances for non-instrument approach, Code 1-A, 37.5 m (123 ft.) Code 1-B 42 m (138 ft.). From centreline to object Code 1-A, 13.5 m and Code 1-B 19.5 m.

Taxiway strip (reference section 13.9.1)(1) width for Code 1-A, 13.5 m centreline to edge of strip, i.e. 27 m wide. For taxiway shoulders no width is recommended. We propose to use 7 m from centreline and slope equal to or less than 5%.

Apron (reference section 16.3.1)(1) parked aircraft not to infringe transitional zoning, i.e. for Code 1-A and 1-B, 1.0:5.0 slope from strip edge, or (reference section 7.3.2) under special conditions for VMC for runways of Reference Code 1, 90 m strip width then 1.0:3.0 slope. Alternatively, 120 m strip width and vertical transverse slope.

Distance from pavement edge to building or object (reference section 16.4.2 for Codes A and B)(1) 7.5 m (25 ft.).

Obstacle Limitations (reference section 2.1.2 of part 2)(1) mobile obstructions:

- Trains - 6 m to top of high rail;
- Trucks 4.5 m; and
- Boats as appropriate.

Inner Edge is located at end of strip. The elevation is that of the threshold. Where practical, the boundary fence should be located to provide a minimum clearance above top of fence of 3 m.

Approach Surface, Non-instrument Approach (reference section 5.1 C).(1) Inner edge width equals the strip width. This is for runway Code 1. Divergence, minimum amount 10%, minimum length 2,500 m, slope maximum 5%.

Outer Surfaces (reference Part 2, Chapter 6.(1) Horizontal plane above aerodrome reference point 45 m or where ground surface is less than 9 m below this surface plane must be extended upwards to provide minimum clearance of 9 m above obstacle. Outer surface radius for runway Codes 1, 2 or 3, 4,000 m minimum radius. Under special circumstances, may use a semi-circular area to permit a circling procedure on one side of runway only.

Lighting (reference Part 3, Chapter 3, section 3.1.1)(1) non-instrument approach, Table 3.1. Low intensity approach lights (optional), low intensity runway edge lights (mandatory). (Note, we propose to use medium intensity, if not significantly more expensive), taxiway edge lighting (same); VASI (PAPI) (optional); REILS (optional); rotating beacon (mandatory); standby electrical power, (optional); lighted wind sock (mandatory).

Reference section 12.6.2, it is permissible to use APAPI in place of PAPI, i.e. two-lighting units rather than four-lighting units.

In addition to the proposed modifications to the geometric standards, we are proposing a unique application of full-strength and reduced-strength pavement sections to reduce costs. This matter is not covered in TP 312E. It is shown in our typical design sketches. Our design incorporates full strength pavement on the runway ends, i.e. the touchdown zones, and a central strip for the full length of the balance of the runway. Either 7.5 m or 10.5 m wide depending upon the design aircraft chosen. The reduced strength pavement proposed is turf or aggregate turf which are adequate to support all three of these aircraft types under normal operating conditions. Neither offers any hazard.

In our designs no provision has been made for installation of pavement edge drainage as a standard item. However, each site should be examined and where required, the lowest cost drains should be installed. For some locations this may mean use of filter fabric filled with crushed rock in a drainage trench rather than installing perforated drain pipes.

The airports are proposed to be used for day and night VMC, not IMC. However, as discussed earlier, we have included a non-Transport Canada approved non-directional beacon, plus extensive visual navigational aids to improve the site locatability and safety when used under marginal visibility conditions. The currently proposed minimum runway width of 15 m and 18 m have been used in our design. However, the consultant's experience in other countries under different conditions is of much narrower runways. This suggests there is room to reduce the pavement width. Similarly, there have been concerns expressed by others that it may be possible to reduce the strip dimensions, primarily in the transverse directions. Only limited information is available on longitudinal and lateral dispersion touchdown patterns for these types of small aircraft. Published data for large jet aircraft indicate that the lateral dispersion on touchdown is very, very small. Savings in a remote airport program may be possible by measuring the actual landing pattern dispersion for small aircraft under similar conditions with the purpose of identifying the minimum safe runway width and length for these operations.

In some respects, primarily length and width, the proposed runway designs are considerably less than those currently being constructed by the Province of Manitoba, many other provinces and the Federal Government for Twin Otter type operations. In light of the very low frequency of accidents recorded at airports under 915 m (3,000 ft.) in Canada, there is some evidence of over emphasis on safety at the expense of higher cost of construction and maintenance. For the air mode the acceptable risk vs. other modes appears to be much lower. However, lack of valid data prevents making a precisely quantified risk assessment for the air mode at this time.

Access Roads

Again, in keeping with developing the minimum cost for service, minimal access road standards are proposed. Two alternatives were considered and the minimal one has been retained. Where on average there would be less than two aircraft movements per day, it is unnecessary to provide a two-lane pavement surface on the access road. For example, at a 400 population community, served by an existing airport, the typical aircraft landings are about 750 per year, or about two per day. A 100 population community would generate about one-quarter of this amount of traffic, or on average, one landing plus one takeoff every second day. Since analysis reveals the cost of constructing an access road 2 kilometers long approaches the cost of constructing the runway, it seems prudent to reduce the design to the minimum acceptable. One-lane roads, while not common in the developed areas of Canada, have been used and are still being used in rural areas under very light traffic conditions such as may occur for these remote, very small communities.

3.1.2 Costs of Construction

Individual site conditions will vary markedly from the average condition used as a basis of costing. References used for costing have been taken from Transport Canada's Construction Cost Reference Data Base for CATA Airport Facilities (TP 3218);(5) manufacturer's costs; discussions with contractors and transportation companies; the Manitoba government and their operators. Officials in the Manitoba government have indicated that for construction of provincial airports in the north, the costs are often very high relative to Transport Canada's average costs in the south due to the remoteness of the location and non-access by ground during the normal construction season. This results in equipment being brought in on winter roads one year and remaining for a full construction season and being brought out the following winter on a new winter road. For sites having all weather roads, or at least a road open in the summer, these delay costs should not be markedly higher than for the southern part of the province. Manitoba officials have indicated that costs are often two to two and a half times higher than those in the Winnipeg area. In our study eight of twelve sites identified for upgrading or new construction are currently served by all weather roads. Twenty-one airports in the northern Manitoba region don't have all weather roads.

In this section, costs are either Transport Canada construction costs for the Winnipeg region or manufacturer's equipment costs plus transport charges over all weather or winter roads, as appropriate. Thus, when evaluating a specific site total development costs will vary depending upon whether or not there are all season, or summer road access vs. winter roads, or no road access available.

3.1.3 Proposed Airfield Design Details

Selection of Runway Length

Runway lengths are determined from requirement of TC's TP 312E and the aircraft manufacturer's operating manual. Lengths are reported in this study for two conditions:

(a) Standard conditions of 15° C, 0 runway slope, 0 elevation above sea level, and 0 wind;

(b) For typical northern Manitoba, critical conditions are 22° C temperature, 0 runway slope, 0 wind and 305 m above sea level elevation. Lengths are determined for paved, gravel and turf surfaces. Factors used to adjust length required from paved sections are taken from the manufacturer's literature and discussions with DHC staff.

Runway Length Requirements

Table 3.1 presents the minimum runway lengths required for safe operation under varying conditions.

Aircraft		Pavement Length (m)					
		Std. Cdn's.			N. Manitoba Cdn's.		
	GTOW kg	Pvt.	Gravel	Turf	Pvt.	Gravel	Turf
C-185	1363 (1)	338	353	367	387	404	420
DHC-6-300 STOL	4545 (1)	235	244	253	259	269	280
DHC-6-300 Conv.	4545 (1)	268	281	293	297	310	324
Citation II	5000 (2)	633	677	706	734	785	818

1. Takeoff Distance to 15 m (50') ht.
2. Takeoff Distance to 10.7 m (35') ht. with one engine inoperative at V_1speed.

Table 3.1 Runway Length Requirements vs. Aircraft and Pavement Surface Types

Selection of Runway Widths

The required width of the runway has been extensively researched and no definitive answer found. DHC-6 aircraft operators and operators of similar aircraft have expressed width requirements of between 15 m and 30 m. Discussions with aircraft manufacturers have indicated widths of 13 m or less are acceptable under most conditions as being safe. An examination of U.S., some European and other nation's standards have revealed widths as narrow as 15 m for DHC-7 class aircraft. There was little information on runway width requirements for the Twin Otter, Citation II class/size of aircraft. A search of published literature did not reveal touchdown dispersion patterns for this kind of aircraft under various operating conditions. It must be kept in mind that in Canada there is a winter season when snow, ice and poor visibility often increase the hazards of landing. Since a primary criterion is to ensure that the runway provides an adequately safe surface for aircraft operations, the design criteria was established whereby the aircraft, if it ran off the side of the paved portion of the runway, would suffer little if any structural damage. In the worst case, it may become stuck in the soil and require a tow onto the pavement. All three of the aircraft are capable of operating off turf runways, thus, no serious difficulty is expected should the aircraft run off the pavement onto a lesser quality grassed area on the shoulders.

While no published data was discovered on lateral dispersion of the touchdown point for small aircraft such as the Twin Otter, there is some related information available. The partially relevant information is contained in the report titled "Height Dispersion Over Threshold, STOL Demonstration", Report No. CPS-76-26 prepared by the TDC, STOL Project Office, 1976.(6) This report presents accurate measurements of height, lateral dispersion, velocity, headwind, crosswind of an MLS equipped Twin Otter as it crossed the runway threshold. In addition, it contains longitudinal touchdown patterns and landing roll under various conditions. While this information is for aircraft equipped with MLS, the report indicates that below 60 m elevation, the approach for landing was made under visual conditions. Further, the runway width was 30 m and the runway length was 610 m with 76 m paved overshoots at either end. Experienced pilots made all of the aircraft landings. Presumably there was no necessity to land along the centreline and within the shortest distance beyond the runway threshold. Significant details are reproduced from the above study.

Reported facts are: the touchdown zone was located between 91 m and 152 m from the runway threshold. Figure 3.1, "Frequency Distribution of Touchdown Points" shows the average touchdown distance was 132 m from the threshold with one standard deviation of plus or minus 41 m. This gives a probability of one landing out of thirty-two falling outside the touchdown zone between 91 m and 173 m from the threshold. At two standard deviations, the touchdowns occurred within 51 m and 214 m distance from the runway end. One of 182 landings fell outside this zone. At three standard deviations, one of 588 landed outside 10 m and 255 m distance from the end.

Figure 3.2, "Frequency Distribution of Aircraft Lateral Position Over Threshold", and Figure 3.3, "Mean Vertical Trajectory for Three Runways" presents the lateral and vertical dispersions of the aircraft's position at the

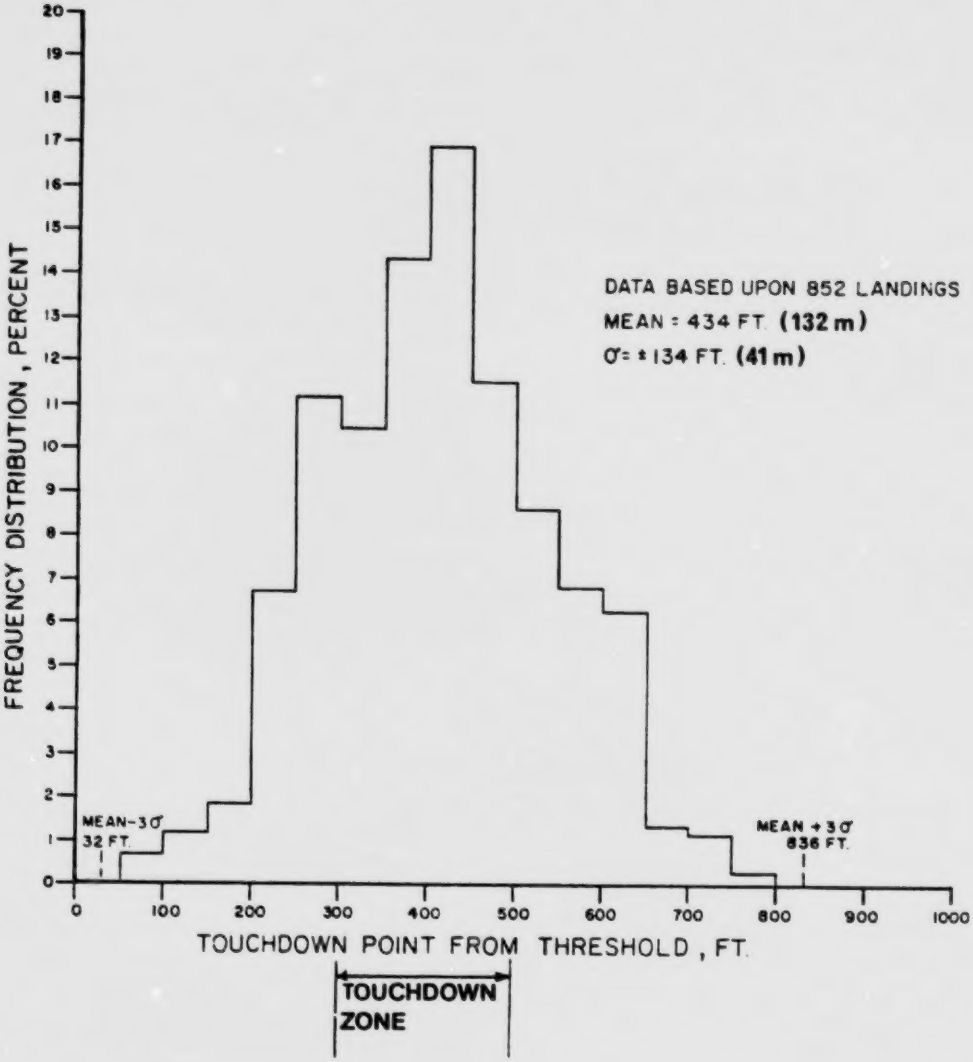


Figure 3.1 Frequency Distribution of Touchdown Points (Rwy 2000 ft + 250 ft Paved Overshoot)

Source: Ref. 6

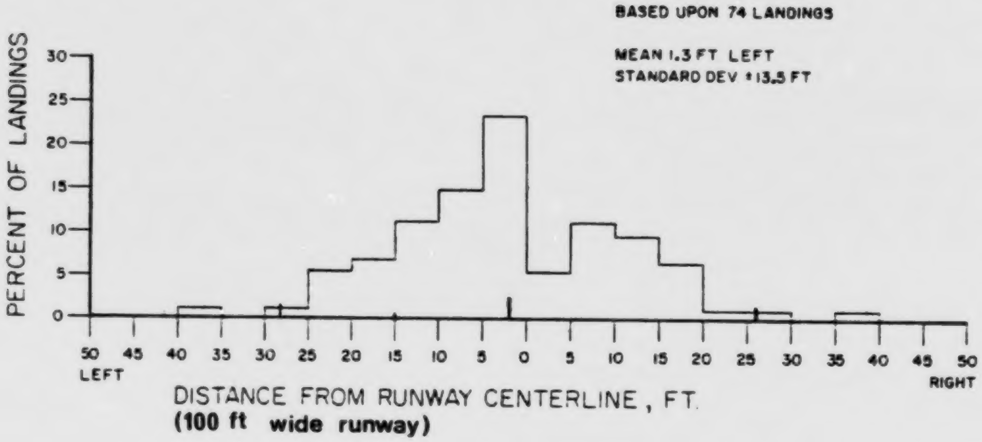


Figure 3.2 **Frequency Distribution of Aircraft Lateral Position Over Threshold**

Source: Ref. 6

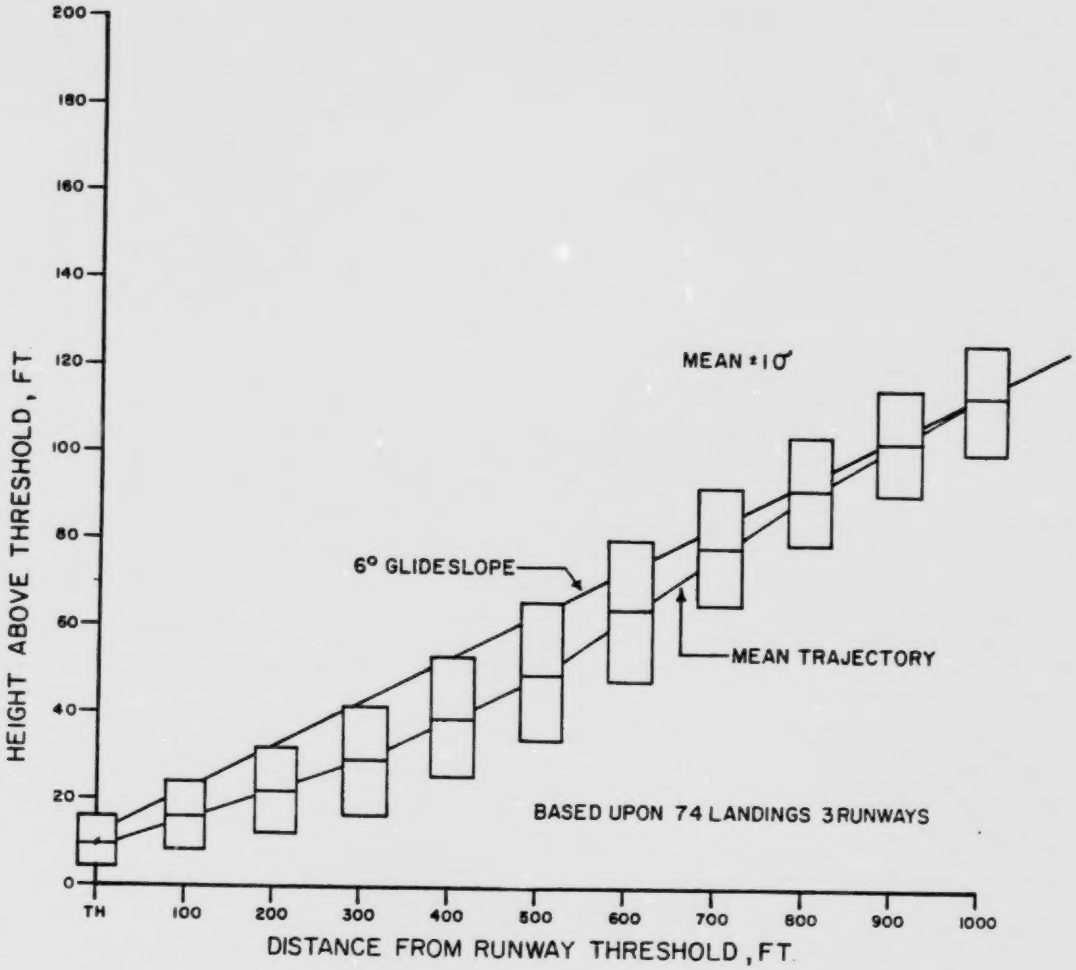


Figure 3.3 Mean Vertical Trajectory for Three Runways

Source: Ref. 6

threshold. Lateral dispersion was an average of 0.4 m left of centreline with a standard deviation of nose wheel of plus or minus 4.1 m. For height, the average height was 3.0 m and a maximum recorded height of 7.0 m crossing the threshold.

Figure 3.4, "Height Over Threshold and True Airspeed" shows the air speed over the threshold at the 3.0 m height. The average air speed was about 37 m per second or about 131 kph. Headwinds over the threshold at the 3.0 m height averaged 4.9 m per second or about 17.5 kph. and crosswinds at the threshold at the same height averaged 4.3 m per second or about 15.2 kph.

Figure 3.5, "Headwind Effect on Touchdown Velocity" shows the headwind effect on the touchdown velocity. The regression equation of the form Y = 112 ft. per second - 0.5X ft. per second was developed where X is the head wind velocity and Y is the absolute touchdown speed. For example, with 6.1 mps (20 ft. per second) headwind the touchdown velocity was 28 mps (92 ft. per second) or 101 kph (63 mph).

Figure 3.6, "Frequency Distribution of Ground Roll Distances" shows the Twin Otter averaged 194 m with one standard deviation of 57 m. Thus at two standard deviations (about 95% of all landings) the ground role varied between some 79 m and 208 m from the threshold.

The relevance of all the previous information is that it provides maximum reasonable limits for ground role and provides some indication of lateral dispersion as the aircraft approaches touchdown. Albeit the readings were taken on an average of 131 m from the touchdown point. Another point of interest is that the aircraft landed at a relatively low 101 kph on average. What is missing is factual information on the actual lateral dispersion at the point of touchdown of the Twin Otter aircraft. Pending location or development of such information, a reasonable but hypothetical analysis of touchdown dispersion is presented in the following section.

Estimate of Touchdown Point Lateral Dispersion for DHC-6 Aircraft

Based upon the following facts and assumptions, the hypothetical probability of the touchdown point for the above aircraft is presented:

(a) Given a narrow runway vis-à-vis a wide runway, a pilot will concentrate more carefully on touching down on the centreline of the narrow runway.

(b) Experienced pilots who are to use these airports will be more capable than average general aviation flyers.

(c) The lateral dispersion on touchdown points for large commercial aircraft follows a normal distribution curve. While they normally land on 43 m to 60 m wide runways, the dispersion with one standard deviation is believed to be less than ± 3 m. This is for aircraft that typically land at approach speeds 1.5 to 2.0 times the landing speed of the Cessna 185 and the Twin Otter.

The distance, outside tire to outside tire, of the main undercarriage of the DHC-6 is 3.8 m (12.5 ft).

The accompanying Table 3.2, "Lateral Dispersion of Main Gear Touchdown Points" presents probabilities of landing outside the centreline for plus or minus 1 to 5 standard deviations.

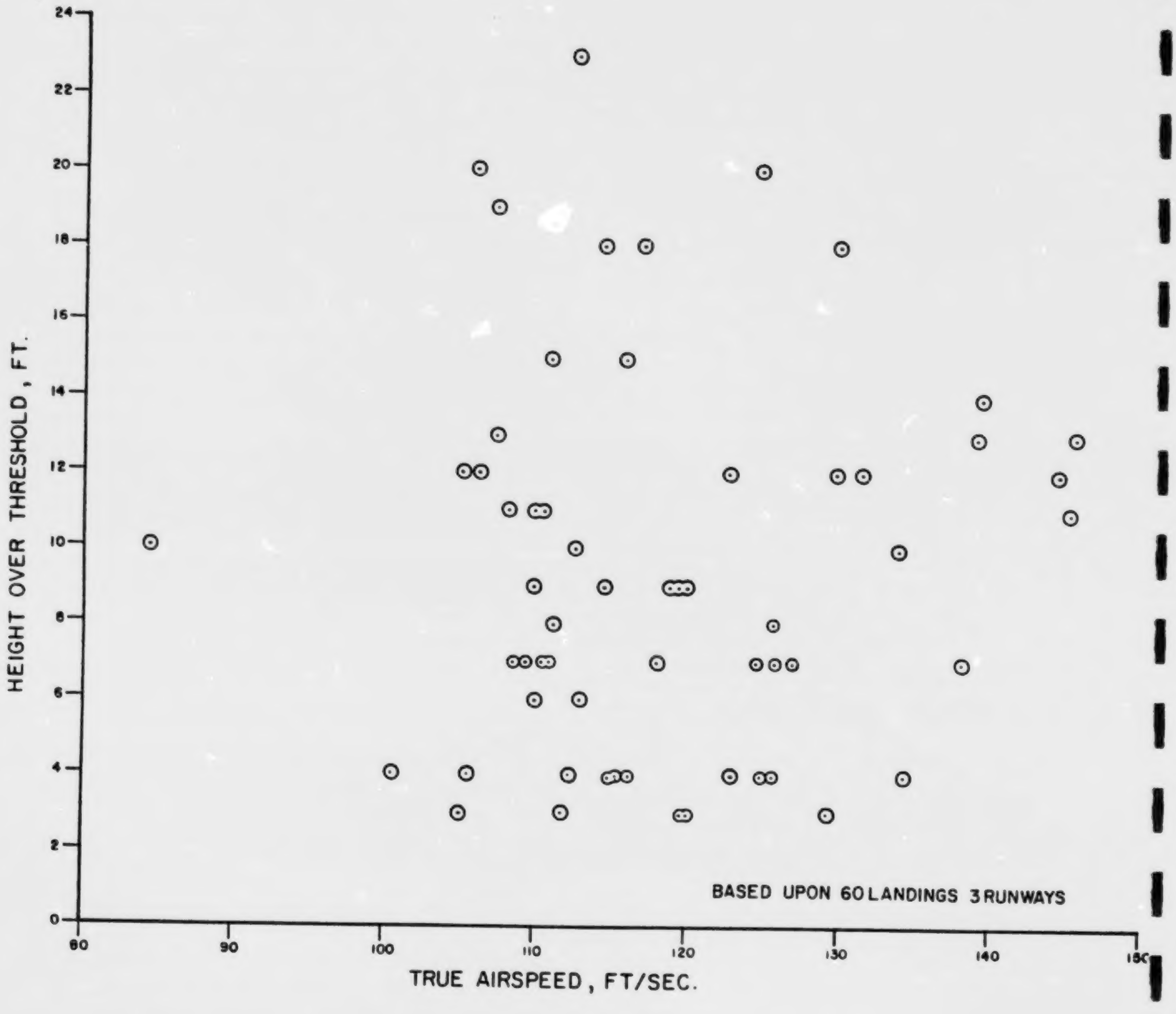


Figure 3.4 **Height Over Threshold and True Airspeed**

Source: Ref. 6

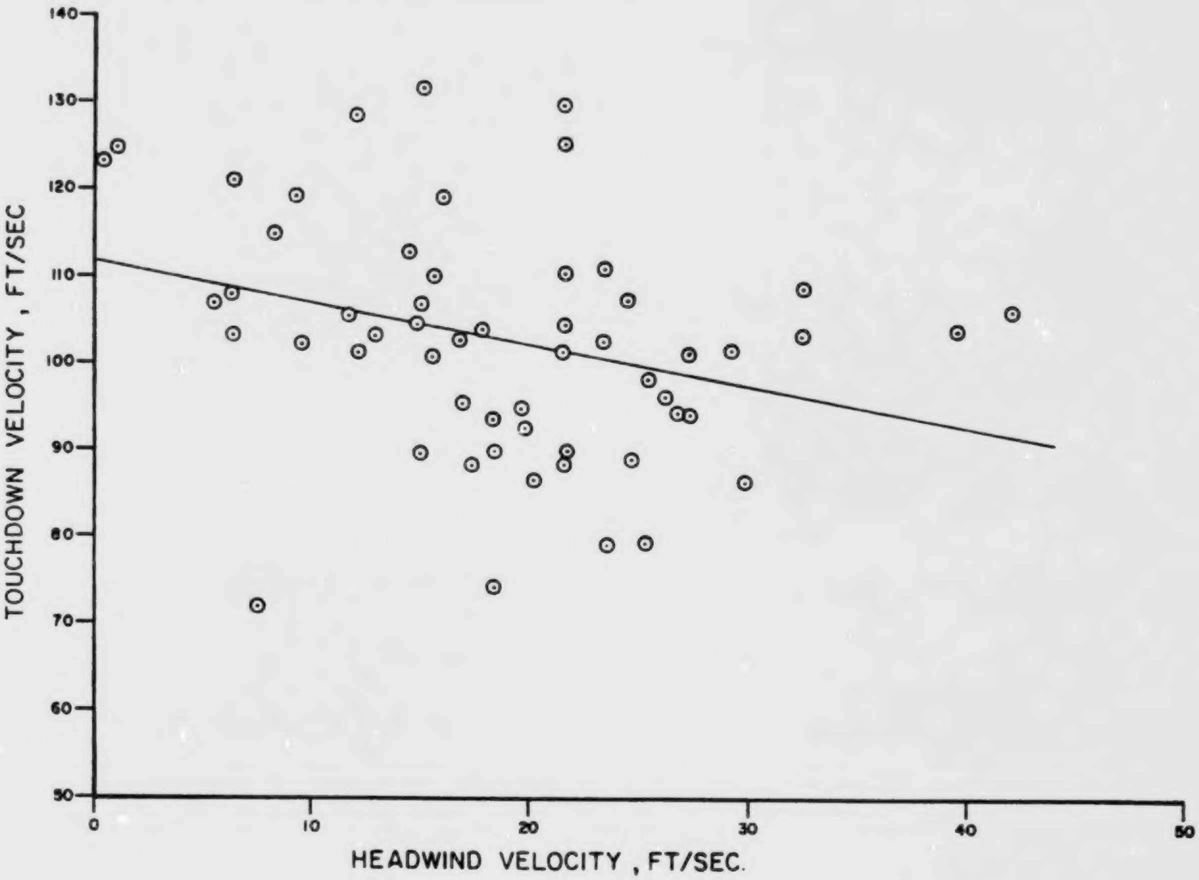


Figure 3.5 **Headwind Effect on Touchdown Velocity**

Source: Ref. 6

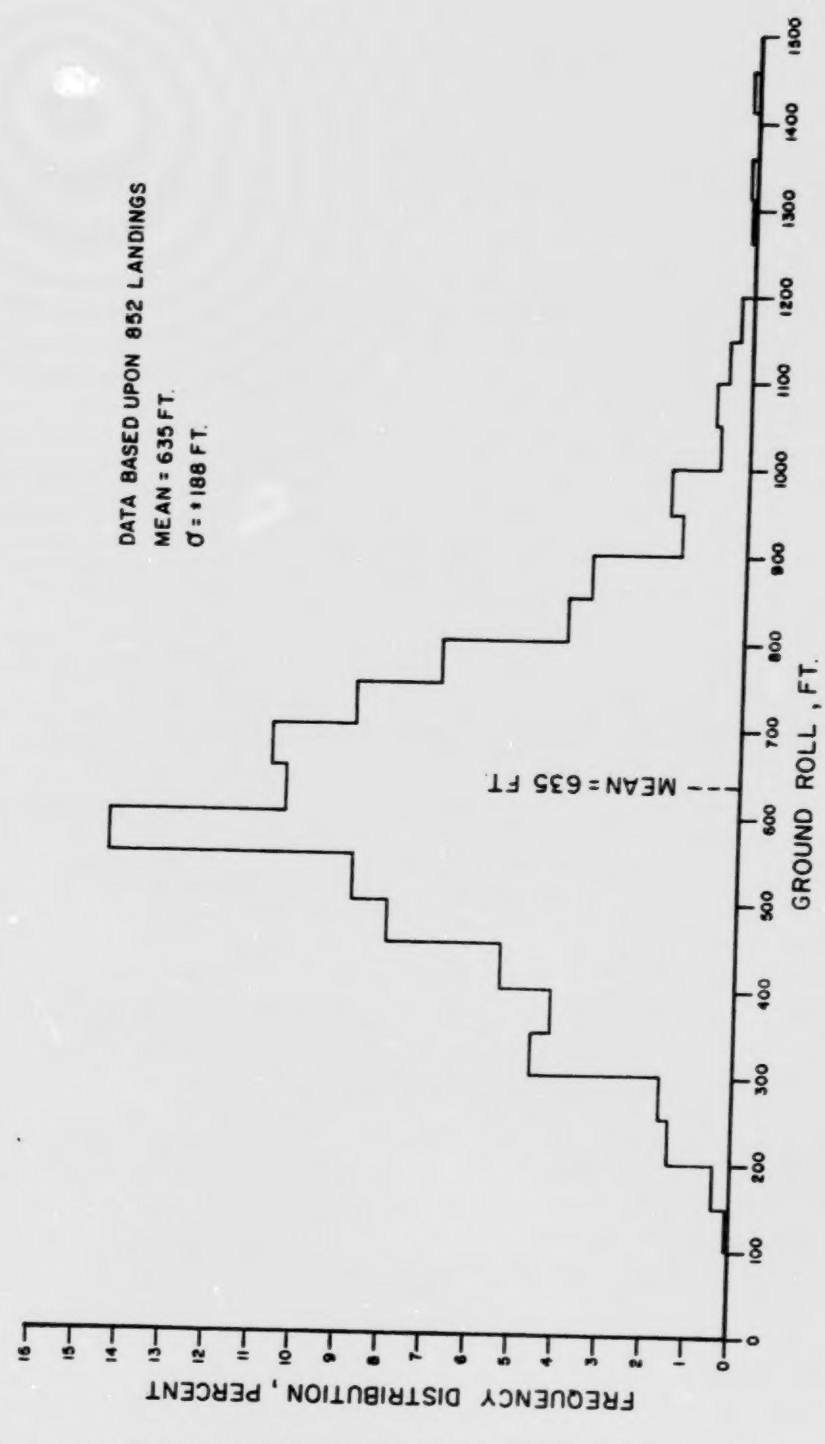


Figure 3.6 **Frequency Distribution of Ground Roll Distances**

Source: Ref. 6

Std. Devia-tions	Probabl'ty of Exceed. 'n' Deviat'n(s) %	Frequency of Exceeding Dispersion 1 in 'n' Landings	Avg. Time Between Exceeding Dispersion yrs.*	Distance Outside of Main Gear Tire from Pavement Edge Twin Otter on 15 m Pvt.	Distance Outside of Main Gear Tire from Pavement Edge Citation II on 18 m Pvt.
1	31.73	1 in 3	0.004	4.5	5.3
2	4.55	1 in 22	0.029	3.3	4.0
3	0.27	1 in 370	0.490	2.1	2.8
4	0.006	1 in 16,700	22.300	0.8	1.6
5	0.00006	1 in 1.67 million	2220.000	-0.4	0.4

* In northern Manitoba, average 400 population community generates 750 landings/year.

Table 3.2 Lateral Dispersion of Main Gear Touchdown Points

Due to the heavier wing loading of the Citation than for the DHC-6 aircraft, the lateral dispersion is expected to be slightly less for the Citation. Assuming an 18 m wide runway, the probability of coming within 0.4 m of the edge of pavement is about 1 in 1.7 M operations, or once in about 2,200 years. For a 15 m wide pavement, the probability of coming just to the edge of the pavement at four standard deviations is about 1 in 17,000 movements, or once in 22 years.

In light of the fact that a minor distance off the edge of pavement on touchdown is not expected to cause any problem to any of these aircraft, it would seem that the 15 m and certainly the 18 m wide runways are more than adequate for this type of operation carried out by experienced pilots.

3.1.4 Conclusions

Assuming that the standard deviation is 1.22 m, there is about one chance in 2 million the aircraft will touchdown off a 15 m wide pavement. For an average community of 400 population receiving 750 landings per year, there will be one runoff occurrence each 2,200 years (based on a single runway at the proposed width). Touching down 0.3 m to 0.5 m off the edge of the pavement is not expected to cause any damage to the aircraft since they all are capable of operating on turf.

3.1.5 Airport Design Details

Suitable combinations of full and reduced strength pavements are developed for the runways and taxiways. These sections are maintained for all pavements, i.e. also the road, apron and vehicle parking lot areas. The strip, runway width and length, approach and lateral clearances are all in accordance with TP 312E. Visual navigation aids requirements are also from

TP 312E for day and night VMC with the one exception, a low cost, non-Transport Canada approved NDB, is provided as an additional aid to:

(a) locate the airport in what may be rather featureless terrain under winter conditions, and

(b) to increase safety and useability under marginal VMC conditions.

A typical remote airport layout is shown in Figure 3.7, "Typical Remote Airport Configuration".

The following sections of this chapter provide information on the airport component alternatives.

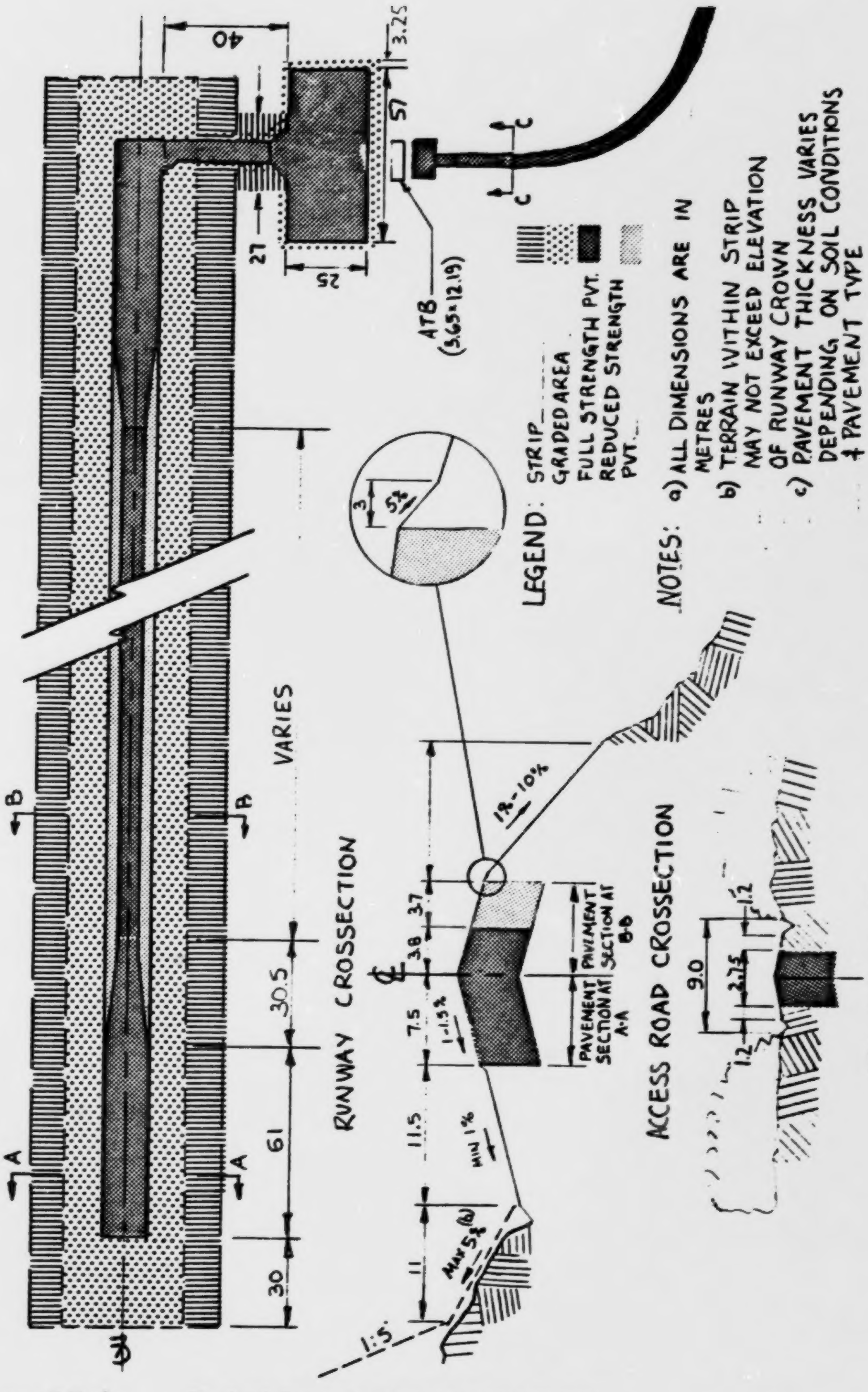
3.2 Facilities Requirements

Descriptions and cost estimates for the various components of a small airport for a remote site are described in this section. Costs estimated are based on equipment, labour and materials prices for Winnipeg unless otherwise indicated. Based on estimates from the Manitoba Government, actual costs at remote sites may be 2 to 2.5 times those incurred at Winnipeg. This high cost index reportedly results from additional transportation costs of equipment and materials, high labour costs and the extra costs incurred if equipment must remain on site longer than normal due to transportation constraints. Some of these factors contributing to the high cost index can be mitigated by careful planning of transportation in and out of the site. Where more than one alternative should be considered, these options are also presented. All facility components considered are listed below, grouped into three categories:

(a) Civil Works (Section 3.3)
    Access Road
    Car Park
    Aircraft Apron
    Taxiway
    Runway

(b) Air Terminal Building and Related Utilities (Section 3.4)
    Air Terminal Building
    Water Supply
    Sewage Disposal
    Power Generation
    Communications

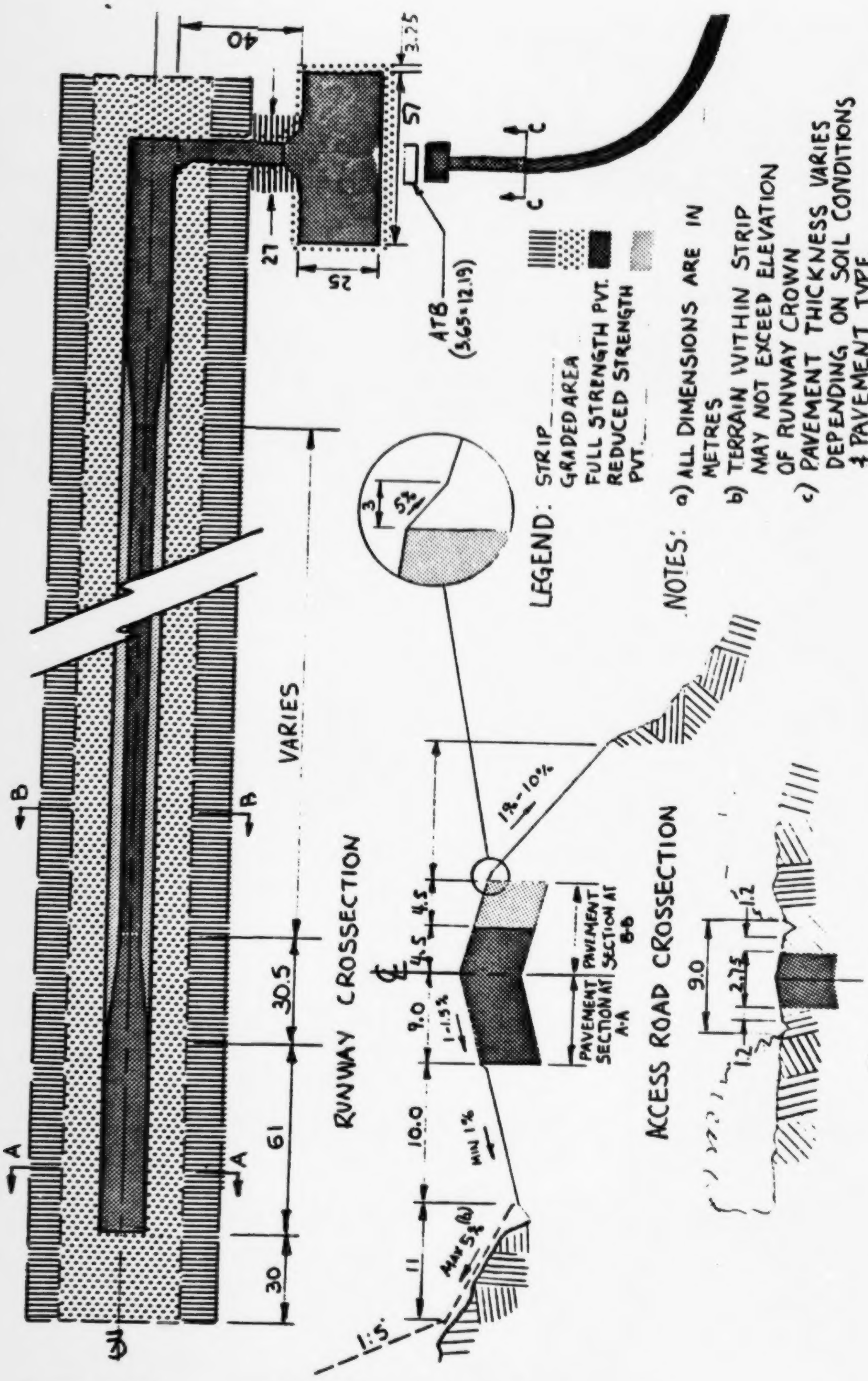
(c) Lighting and Navigational Aids (Section 3.5)
    Rotating Beacon
    Edge Lighting
    Apron Lighting
    Illuminated Wind Indicator
    Runway End Identification Lighting (REIL)
    Low Intensity Approach Lighting
    Precision Approach Path Indicator (PAPI)
    Non-Directional Beacon (NDB)



40
3.25
57
27
25
ATB (3.65×12.19)
C
C
B
B
A
A
VARIES
30.5
61
30
RUNWAY CROSSECTION
7.5
3.8
3.7
11.5
11
1-1.5%
MIN 1%
MAX 5%
1:5
1%-10%
3
5%
PAVEMENT SECTION AT A-A
PAVEMENT SECTION AT B-B
ACCESS ROAD CROSSECTION
9.0
2.75
1.2
1.2
SECTION AT C-C
LEGEND: STRIP
GRADED AREA
FULL STRENGTH PVT.
REDUCED STRENGTH PVT.
NOTES: a) ALL DIMENSIONS ARE IN METRES
b) TERRAIN WITHIN STRIP MAY NOT EXCEED ELEVATION OF RUNWAY CROWN
c) PAVEMENT THICKNESS VARIES DEPENDING ON SOIL CONDITIONS & PAVEMENT TYPE

Figure 3.7 a) **Typical Remote Airport Configuration (C-185/DHC-6 Type)**

Source: R.S. Wallace & Associates Ltd.


40
3.25
57
27
25
C
C
ATB
(3.65×12.19)
VARIES
B
B
A
A
30
61
30.5
RUNWAY CROSSECTION
℄
9.0
4.5
4.5
1-1.5%
10.0
MIN 1%
11
MAX 5% (b)
1:5
1%-10%
3
5%
PAVEMENT SECTION AT A-A
PAVEMENT SECTION AT B-B
ACCESS ROAD CROSSECTION
9.0
2.75
1.2
1.2
SECTION AT C-C

LEGEND:
- STRIP ▤
- GRADED AREA ▒
- FULL STRENGTH PVT. ■
- REDUCED STRENGTH PVT. ░

NOTES:
- a) ALL DIMENSIONS ARE IN METRES
- b) TERRAIN WITHIN STRIP MAY NOT EXCEED ELEVATION OF RUNWAY CROWN
- c) PAVEMENT THICKNESS VARIES DEPENDING ON SOIL CONDITIONS & PAVEMENT TYPE

Figure 3.7 b) **Typical Remote Airport Configuration (Citation II Type)**

Source: R.S. Wallace & Associates Ltd.

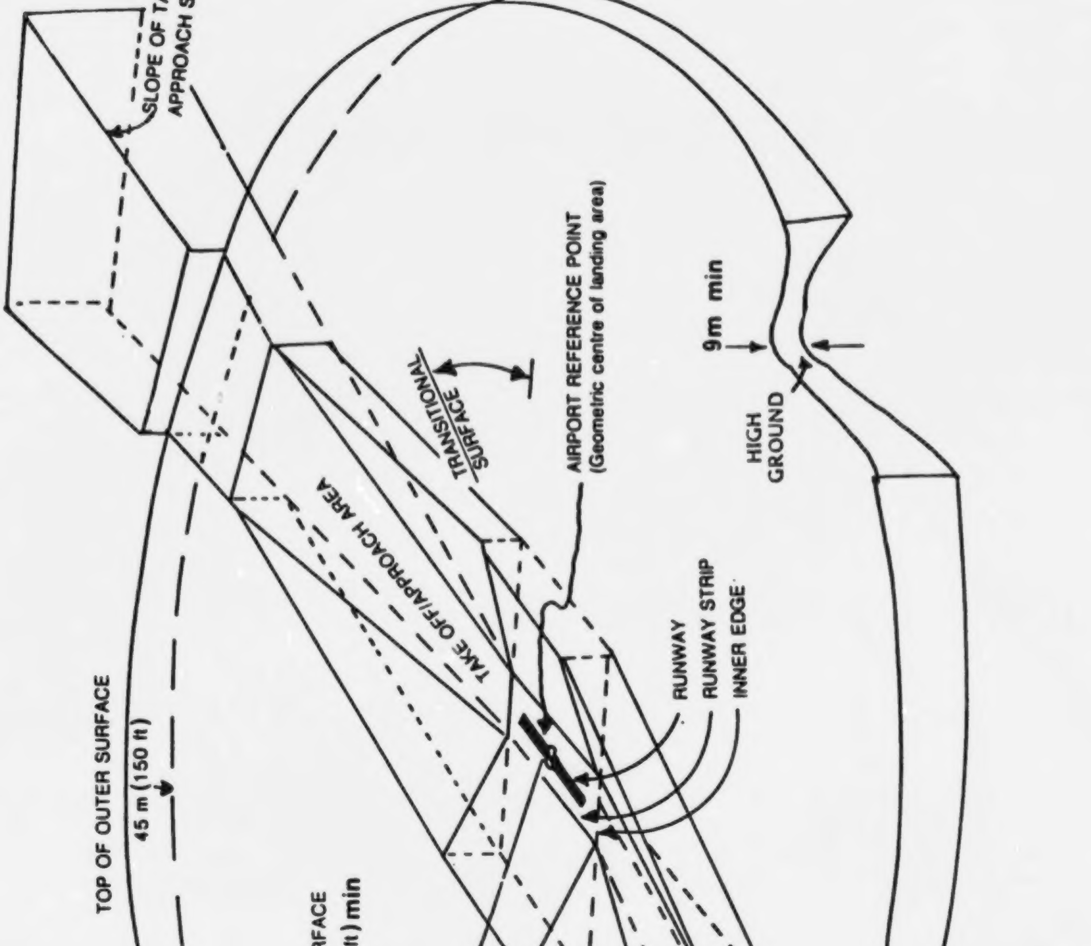

SLOPE OF TAKE OFF/ APPROACH SURFACE
TRANSITIONAL SURFACE
AIRPORT REFERENCE POINT (Geometric centre of landing area)
9m min
HIGH GROUND
TAKE OFF/APPROACH AREA
RUNWAY
RUNWAY STRIP
INNER EDGE
TOP OF OUTER SURFACE
45 m (150 ft)
RADIUS OF OUTER SURFACE 4,000 m (13,000 ft) min
2500 m

Figure 3.7 c) **Airspace Requirements**

Source: Ref. 11

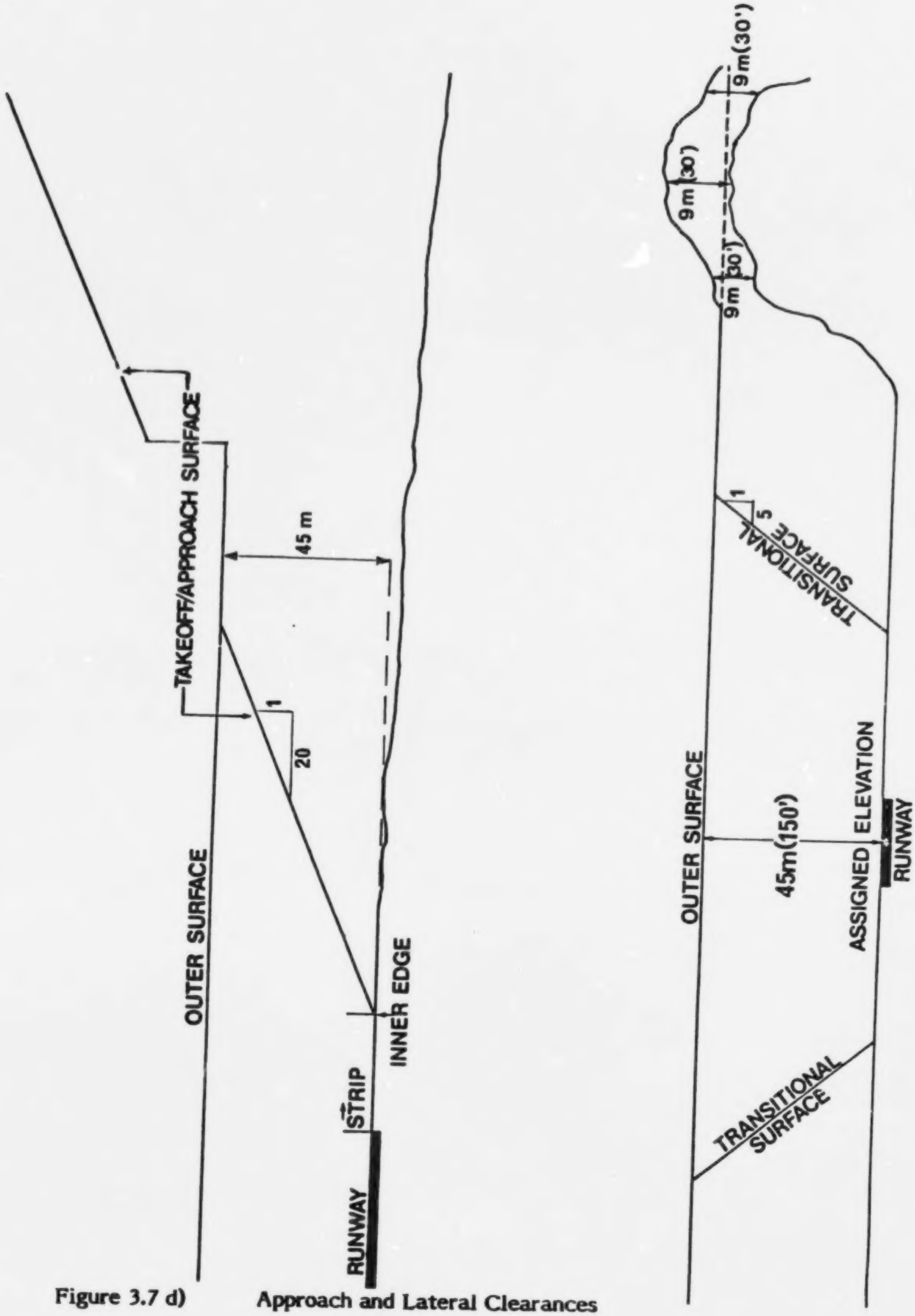

OUTER SURFACE
TAKEOFF/APPROACH SURFACE
45 m
1
20
INNER EDGE
STRIP
RUNWAY
9m(30')
9m
30'
9m
30'
1
5
TRANSITIONAL SURFACE
OUTER SURFACE
45m(150')
ASSIGNED ELEVATION
RUNWAY
TRANSITIONAL SURFACE

Figure 3.7 d) **Approach and Lateral Clearances**

Source: Ref. 11

3.3 Civil Works

Civil works are comprised of all facilities pertaining to pavements. Two aspects of these pavements are structural characteristics and dimensional characteristics. Since the loads imposed by small aircraft, less than 5680 kg are similar to those applied by small road vehicles, the same structural considerations apply to both the airside and groundside pavements. Depending on the subgrade strength, type of native soil, drainage conditions and the types of aggregate materials available, different types of pavements may be used. These pavement types are described in Section 3.3.1. The dimensional characteristics are described for each pavement facility in Section 3.3.2.

3.3.1 Pavement Structure

All of the pavements require clearing, grubbing and grading of the land for a subgrade surface on which a pavement can be placed. In addition to this common element, various alternatives for constructing the pavement section can be used. Table 3.3, "Summary of Pavement Alternatives" summarizes the alternatives for pavement structure with respect to: application; required construction equipment; and cost for typical pavement sections to support light aircraft. More detailed descriptions of these pavements are included in Appendix A. Since the estimated costs may vary considerably depending on the site conditions, the choice of pavement type can only be made taking these into consideration. The costs for pavements were developed using unit costs from numerous references which are included in Appendix A.

While the need for ground frost protection was considered, for economic reasons and the low speeds of the aircraft, none was incorporated into the pavement designs. Frost heaving, in the worst case, will result in temporary runway closure while grading takes place.

3.3.2 Dimensions of Pavement Facilities

The pavement dimensions for each of the pavements are described in subsections 3.3.2.1 to 3.3.2.5. The cost of these facilities is estimated excluding the pavement section since this is a variable element.

3.3.2.1 Access Road and Car Park

A road connecting the airport to the existing road network in the community is an integral part of an airport development project. The minimum standard described below is based on a very low volume of traffic. It is used by the Ontario Ministry of Transportation and Communications for their remote airports where such traffic conditions are expected. The volume of local traffic, and local topographic conditions, may dictate a different standard at some locations. Such an alternative road section provides a single lane road. Vehicles passing would each place one side of their vehicle on the stable soil shoulder while passing. This road would be adequate for low volumes of traffic of up to 20 to 40 vehicles per day. At small remote communities of 50 - 100 persons this should be adequate. The alternate standards considered are presented below. The "Alternative Design" was retained for the analysis.

Pavement		Application Conditions	Minimum Construction Equipment Requirements								Typical Section Required for Pavement to Serve Light Aircraft (DHC-6)	
Type	Description		Dump Trucks	Water Trucks	Grader	Combination Loader/Backhoe	Roller	Disc Harrow	Roto Tiller	Bitumen Distributor	Description of Section	Cost in Dollars per Square Metre*
Gravel Pavement	- conventional pavement using granular aggregates for both base and surface courses.	- used if adequate aggregate is available in proximity to the site.	⊗	⊗	⊗	⊗	⊗				- 200 mm of aggregate	$ 3-4**
Portland Cement Soil-Cement Pavement	- native soil, typically mixed with Portland Cement (4-10% by weight) to form a durable structural layer with slab like properties. - topped with bituminous surface treatment.	- generally used with cohesionless native soils but some clay content is allowable - used if adequate aggregates are not available.		⊗	⊗	⊗	⊗	x	○	⊗	- 145 mm of soil cement - 10% cement by weight - bituminous surface treatment	$5-6
Soil-Bitumen Soil-Cement Pavement	- native soil mixed with Bitumen (4-10% by weight)	- used with cohesionless native soils with no clay present. - used if adequate aggregates are not available.		⊗	⊗	⊗	⊗	x	○	⊗	- 170 mm of soil cement - 6% cement by weight	$6-7
Aggregate Turf Pavement	- mixture of coarse single-sized aggregate (25-35mm) with native soil. - surface is seeded to provide grass wearing surface.	- used with relatively stable native soil such as sand silt or clay. - used if aggregate is limited/costly.	⊗	⊗	⊗	⊗	⊗	x	○		- 200 mm of aggregate-turf pavement with 50% aggregate 50% native material. - grass surface.	$2.50-3.50**

Table 3.3 Summary of Pavement Alternatives

Pavement		Application Conditions	Minimum Construction Equipment Requirements								Typical Section Required for Pavement to Serve Light Aircraft (DHC-6)	
Type	Description		Dump Trucks	Water Trucks	Grader	Combination Loader/Backhoe	Roller	Disc Harrow	Roto Tiller	Bitumen Distributor	Description of Section	Cost in Dollars per Square Metre*
Screen-Stone Paving Block Pavement	- cast on site screen stone (webbed) paving blocks, placed on bedding material on sub-grade. - voids in screen stone are filled with topsoil and seeded.	- used if adequate aggregates are not available. - used if inexpensive labour can be found to cast paving blocks on site and place them.	X		⊗	⊗	⊗				- 100 mm concrete paving blocks with minimal bedding. - grass surface in voids of paving block.	$26
Aluminum Landing Mat Pavement	- prefabricated aluminum planks linked together and placed on subgrade.	- used if adequate aggregates are not available. - used if labour is relatively expensive.			⊗		⊗				- 100 mm aluminum planks on subgrade.	$71***
Geoweb Pavement	- prefabricated plastic lattice geoweb placed on subgrade, filled with native material and topped with bituminous surface treatment.	- used if adequate aggregates are not available. - used if native material is anything but organic soil.		⊗	⊗	⊗	⊗			⊗	- 100 mm geoweb filled with native soil. - bituminous surface treatment.	$11-12

* Unless otherwise indicated, pavement costs are based on materials, labour and equipment costs for Winnipeg/Southern Ontario (see Appendix A).
** Based on aggregate haul distance of 5 km at $0.10 per tonne km.
*** Includes cost of transporting prefabricated plank.
X Minimum Equipment Normally Required by Contractor.
○ Minimum Equipment Required if Community Members participate in Construction.
⊗ Minimum Equipment Required Either by Contractor or by Community Members.

Source: Appendix A

Table 3.3 Cont'd.

	MTC Std.	Alt'n Design
Width of clearing	9 m	9 m
" travelled portion (pavement)	4.25 m	2.75 m
" shoulder	1.2 m	1.95 m

Based on both the MTC standard and the alternate, the cost (excluding pavement section but including clearing, grubbing, drainage and excavation) for an access road is \$55.50 per linear metre of road. For a typical assumed access road length of 2000 m this is \$111,000, plus the cost of pavement (variable with width and type).

The car park provides a paved area to park vehicles of airport users. An area of 100 m^2, adequate to park five cars, would serve this need. The cost for this area would be \$850 excluding pavement, but including clearing, grubbing and excavation.

3.3.2.2 Apron and Taxiway

An aircraft apron is necessary to park itinerant aircraft. A 1425 m^2 apron will accommodate two Twin Otter aircraft. The cost of this apron is \$13,600 (for clearing grubbing and common excavation) plus the cost of pavement. For VMC a 40 m long taxiway is necessary between the runway and apron to provide this connection, yet meet the transitional zoning requirements for aircraft parked on the apron. The cost of this taxiway is \$440 per metre of taxiway including grubbing and common excavation, but excluding the cost of pavement. The cost of clearing this area is included in the cost of clearing for the runway.

3.3.2.3 Runway

Many standards were consulted and interviews were conducted with pilots to determine the appropriate standards to consider for remote airports. Among the standards considered were the minimum standards of Transport Canada, Federal Aviation Administration, Ohio State and Minnesota. These are tabulated in Table 3.4, "Minimum Runway Dimension Standards".

The cost of a non-instrument runway for VMC is \$105 x (Strip Length in metres) + \$42,000 + \$8.6 (Strip Length in metres) x (Graded Area Width in metres), plus the cost of pavement.

3.4 Air Terminal Building and Related Utilities

3.4.1 Air Terminal Building

The air terminal building would be provided to give the airport operator an office and shelter to any waiting passengers or small cargo. A trailer type portable building such as the one specified in Table 3.5, would meet this need in the most efficient manner. A plan of this unit is shown in Figure 3.8, "Air Terminal Building". It has two doors to the exterior, an office at one end and a washroom between the office and waiting area which is at the other end.

	Transport Canada(1)	Federal Aviation Administration(7)	Ohio State(8)	Minnesota(9)
Runway Pavement Width (m)	15(a) 18(b)	18(a) 23(b)	23	18(d)
Graded Area Width(m)	38	36(a) 45b2)	45	(e)
Graded Area Length(m) (beyond end of runway)	30	72(a) 90(b)	30	(e)
Runway Strip Width(m)	60/90/120	150	122	(e)
Transitional Zoning	1:5/1:3/vertical	vertical	vertical + 1:7(c)	(e)
Approach Slope	1:20	1:20	1:30	(e)
Taxiway Width	7.5(a) 10.5(b)	7.5(a) 10.5(b)	9	(e)
Taxiway Strip Width	27(a) 39(b)	15(a) 24(b)	-	(e)

(a)	Cessna 185
(b)	Twin Otter & Citation II
(c)	From 12m up
(d)	Paved
(e)	Use FAA Standards

Table 3.4 Minimum Runway Dimension Standards

Manufacturer: ATCO industries (NA) Ltd.
Model No: 1240-2
Dimensions: 3.65m x 12.19m

Interior: Paneled Walls/Vinyl Floor Covering
Exterior: Metal Siding and Roof
Insulation: Walls 6.35cm Fiberglass
Floor and Ceiling 7.62cm Fiberglass
Heating: Baseboards (14.6 kw nominal power requirement)

Cost: $14,100 plus transportation from ATCO in Winnipeg

Source: Ref. 10

Table 3.5 Air Terminal Building Specifications

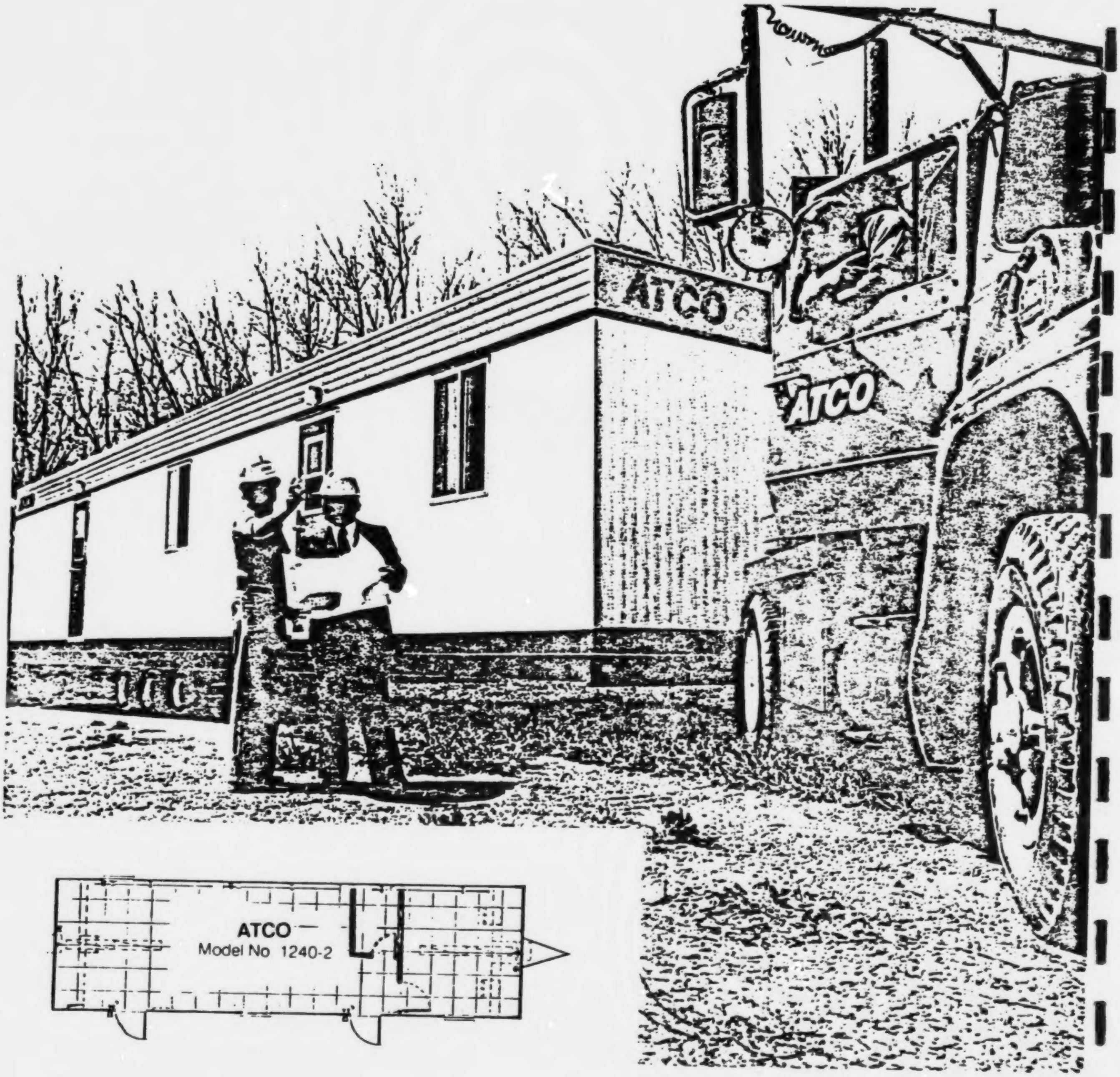

ATCO
ATCO
ATCO
Model No 1240-2

Figure 3.8 Air Terminal Building

Source: Ref. 10

The office will accommodate the radio equipment and meteorological equipment, plus a desk for the operator. The washroom will serve both the passengers and the operator. The waiting space of approximately 30 m^2 is adequate for 20 occupants. (Source TC S.T.E.P. Manual, July 80.)

The cost of $14,100 for the unit is F.O.B. in Winnipeg. Transportation of this unit costs approximately $1.50 per km along paved roads and about $2.00 per km along winter roads. Assuming transportation of 800 km, half on paved roads and half on winter and other roads, the delivered cost is $16,000.

3.4.2 Water Supply

A well would be drilled to ensure year round water supply. To avoid problems of supply pipes freezing during the winter, a submersible pump such as the one specified in Table 3.6, "Water Supply System Specifications" would be used. This system can be set up with valves allowing the water to be drained if the building is left unheated during the winter. If electrical power is available a heat tape can be installed on the water lines within the frost zone. Since the pump is submerged, no priming is necessary to reinstate the system. The total cost for such a system including a drilled well 30 m deep is about $5000.(13,14)

Pump - Submersible such as Red Jacket's Water Bear Model E33TO-CN9AD manufactured by Wylain Canada Ltd.
- 9 stages
- 1/3 horsepower
- 115 volt single phase

Galvanized Glass Lined Tank
- with air relief valve
- 200L capacity

Pipes
- 2.54 cm dia
- Poly Vinyl Chloride (PVC)

Power Cable
- No. 14/3
- twisted submersible cable

Source: Ref. 11

Table 3.6 Water Supply System Specifications

3.4.3 Sewage Disposal

To dispose of sewage, a prefabricated polyethelyne septic tank of 5000 L capacity would be used. Poleythelyne was chosen as a material due to its light weight for transportation. The total cost for such a system including the lateral, tank and tile bed would be about $1600.(5,12)

3.4.4 Power

Power would be provided via land lines from the local community. Where commercially supplied power is unavailable, a generator must be provided. A diesel generator set capable of carrying a 20 kw load would meet this need. This set includes transfer panels, a bypass switch, fuel tank and ventilation fans. It would be housed in a small prefabricated metal enclosure with ducts for ventilation. The total cost for this type of power supply would be $30,000.(5)

3.4.5 Communications

Communications to be provided are land communications linking the airport with other population centers and ground to air communications linking the pilot to the airport.

Reliable land communications from the terminal to alternate airports and sites with airport and hospital facilities are necessary to provide effective emergency service. Unless this link is reliable, aircraft can not be dispatched to pick up casualties. Ground to air radio is necessary to link the pilot to the airport, once he is in the vicinity of the airport. This allows the airport operator to communicate detailed atmospheric and runway conditions to the pilot.

3.4.5.1 Land Communications Equipment

If telephone lines are available they are the best alternative for land communications. Where telephone lines are not available or too costly to install, radio must be used. Two types of radio equipment should be considered: high frequency low band radio for short range communications less than 80 km; and high frequency single side band for medium/long-range communications beyond the 80 km range. Specifications for typical radio communications equipment for both these overland links is shown in Table 3.7, "Specifications for Typical Radio Communications Equipment". There is a gap, however, between these radio systems since the typical range of the low band radio is a maximum of 80 km, but the minimum for high frequency single side band radio is typically 240 km. This gap can be filled by improving the short range performance of the high frequency single-side band radio by using a vertical whip antenna and an antenna tuner.(13) This improves the short-range performance at an additional cost of aproximately $5000 bringing the total cost of the single-side band radio up to about $9500.(13) Another alternative is the addition of repeater stations to receive and transmit the low band radio signal at 80 km intervals. However, this addition of repeaters is quite costly at approximately $14,000 each, which is more than two times the cost of the base station.(13) It should be noted, however, that the typical ranges given are nominal. The actual ranges of the equipment are highly dependent on terrain conditions between the transmit/receive points. A detailed analysis of the site will determine the exact requirements with respect to land radio communications, particularly in the 80 - 240 km range.

Another possibility for bridging this gap in range without major expenditures on antennas or repeaters etc. is the use of high frequency single side band radio in conjunction with the telephone system. This could be done by using the high frequency single side band radio to communicate with a point which is ideally within its range (further than 240 km away). At this point the call could be patched into the telephone system which could be used to communicate with any intermediate locations. This alternative is suggested if transmission in this range is only occasionally required.

	Use of Equipment		
	Ground to Air	Short Range Over Land	Medium/ Long Range Over Land
Manufacturer:	Comco Communciations Co.	Motorola Ltd.	Motorola Ltd.
Model No.:	727	L71JJB	D70SJA1G00-K
Type:	Very High Frequency Amplitude Modulation	High Frequency Low Band	High Frequency Single Side Band
Frequency Range (MHz):	118-136	29.7-50	2-10.8
Typical Communications Range (km):	8	up to 80	240 up
Power Supply:	120 V AC or 12V DC	120 V AC or 12V DC (optional)	12V DC or 120 V AC (optional)
Output Power (W):	5	110	100
No. of Channels:	6	4	20
Cost Installed with Antenna	$2100	$5000	$4500
Source:	Ref. 14, 15	Ref. 16, 17	Ref. 16, 17

Table 3.7 Specifications for Typical Radio Communications Equipment

Patching into the telephone system with single side band equipment is ideal, since the radio operator can speak directly to anyone with telephone service. However, it requires that a radio operator be present to manually make the connections at the other end. Some more sophisticated single side band equipment called "RACE", which is manufactured by the Canadian Marconi Co., integrates single side band radio with the telephone system at both ends automatically. This allows the user to dial directly at the remote end. The single side band radio makes the link to a central master controller and patching into the telephone network is done automatically at the master controller. Such a system could be set up to link as many as 16 remote sites to one master controller at a cost of approximately $20,000 per site, plus $20,000 for the master controller.(13)

3.4.5.2 Ground to Air Communications Equipment

Ground to air communications can be provided using the very high frequency (VHF) amplitude modulation (AM) radio which is specified in Table 3.7. This radio has a typical ground to air range of 8 km.

3.5 Lighting and Navigational Aids

3.5.1 Rotating Beacon

The rotating beacon is used to visually guide pilots to the airport. This visual aid is necessary for night operations. A two-lamp beacon is described in Table 3.8, "Specifications for Rotating Beacon".

Manufacturer:	ADB Alnaco
Model No:	RB-2-1000A
Flash Rate:	24 per minute
Power:	1000 Watts per lamp
Power Requirements:	120 VAC @ 60 Hz
Cost (including installation with heater and thermostat):	$4,000

Source: Ref. 18, 19

Table 3.8 Specifications for Rotating Beacon

3.5.2 Edge Lighting

Medium intensity edge lighting will be provided for the runway and taxiway if the airport is to be used for night operations. These lights are located along the runway and taxiway edges at a spacing of 60 m. A typical light unit that would be used for runway and taxiway edge lighting is described in Table 3.9, "Edge Lighting Unit Description". Parallel circuitry would be used with 3 wires (115-230 volts) and direct connections to each fixture lead. This type of system is more economical for such small runways. It is also advantageous at remote sites since electricians without specialized training can carry out the maintenance. For a 450 m runway, plus a 52 m taxiway, the cost of edge lighting would be about $18,000.

Manufacturer:	ADB Alnaco
Model No:	L-861-1
Features:	Cast Aluminum Head Assembly with Prefocus Lamp Base Socket Frangible Coupling Stake for Mounting Clear Lens for Runway Edge Blue Lens for Taxiway Edge 45 Watt Lamp

Source: Ref. 5, 18

Table 3.9 Edge Lighting Unit Description

3.5.3 Apron Lighting and Illuminated Wind Indicator

Apron lighting would be provided for parking and manoeuvering of aircraft during night operations. Adequate illumination can be provided using one pole and two floodlighting fixtures at a cost of $2,800 installed.(18)

The wind indicator is necessary for pilots to ascertain wind conditions. It must be lighted for night operations. An illuminated wind indicator suitable for a small airport has a 90 cm wind sock; a 150 watt lamp holder and is mounted on a 4.8 m stationary steel pole. The installed cost of such a unit is approximately $1,800.(5,18,19)

3.5.4 Runway End Identification Lights

Runway End Identification Lights are installed to provide rapid positive identification of the approach end of a runway. The system consists of two synchronized flashing lights, one on each side of the runway landing threshold facing the approach area. The WS-60 strobeam described in Table 3.10, "Runway End Identification Light Descriptions" would be adequate for applications at remote airports.

Manufacturer:	ADB Alnaco
Model No:	WS-60
Flash Rate:	2 flashes per second
Line Voltage:	220 VAC to 250 VAC
Power Requirement:	Average 500 VA
Installed Cost:	$13,600 per runway end

Source: Ref. 5,18,19

Table 3.10 Runway End Identification Light Description

3.5.5 Low Intensity Approach Lighting

Low intensity approach lighting is installed to provide the pilot landing an aircraft with visual guidance as to his alignment with respect to the runway centreline.

This system consists of a 900 m long row of 15-double light fixtures spaced at 60 m intervals along the extended runway centreline out from the approach threshold. As for edge lighting, parallel circuitry would be used for the approach lighting system. A typical approach light unit is described in Table 3.11, "Approach Lighting Unit Description".

Manufacturer:	Crouse Hinds Lighting
Model No.:	P4390 - VAW-42962
Features:	Two Fixtures Two 100 watt - 120 volt lamps Slip Fitter Base Yellow Lens

Source: Ref. 20

Table 3.11 Approach Lighting Unit Description

These fixtures would be mounted with frangible couplings on either columns (for a maximum height of 1.5 m) or towers for higher fixtures. Assuming that columns will be used throughout, a low intensity approach lighting system for one runway end would cost approximately $25,800.(5)

3.5.6 Precision Approach Path Indicator

The precision approach path indicator (PAPI) system is an approach system for providing vertical slope guidance, which has been accepted by the International Civil Aviation Organination (ICAO) as a substitute for the visual approach slope indicator system (VASIS). Approach slope information provided by PAPI is visual, similar to that provided by VASIS. It is however, more accurate, more energy efficient, has an adjustable glide slope and requires less terrain for installation. A PAPI unit suitable for application at small remote sites is manufactured by Crouse-Hinds Lighting (Style No. 3627D26G01). With 4 units required per runway end, the installed cost is approximately $33,000 per end.(14,20) A lower cost modified system called APAPI can be considered on a site specific basis.(1)

3.5.7 Non-Directional Beacon

While the runways are designed for operation under day/night VMC, due to their remoteness and small size, a relatively low powered, non TC standard NDB is proposed. The reasons for it not being to TC standards is to reduce the cost to about $9,000 from a TC approved system costing about $100,000. . Due to the lack of redundancy of components the proposed NDB will not have the reliability of a TC approved system. However, having one available 99.9% of the time needed is better than nothing due to cost.

An NDB can serve as both an enroute and approach navigational aid. The installation at a remote airport is considered to operate primarily as an approach aid. The NDB signal is received by the airborne automatic direction finder (ADF) system providing the pilot with the relative bearing to the NDB transmitter. The NDB allows for a circling or "straight-in" approach depending on the location of the NDB and the runway characteristics. This can increase the useability of the airport considerably. Actual increases in useability are dependent on the type of approach possible and the atmospheric conditions at the site.

The specifications for an NDB system to serve a remote site are listed in the following Table 3.12.

Manufacturer:	Spilsbury Communications Ltd.
Model No:	LWX-100A
Frequency Range:	200-535 KHz
Power Output:	Adjustable to 100 Watts PEP
Identifier:	Morse Code - Any 3 letter/number combination
Keyer Rate:	3 times per minute
Power Requirements:	115 or 230 VAC @ 215 Watts or 36VDC @ 4.5 Amps
Cost (incl. heated/ cooled enclosure, antenna and installation):	$9,000

Source: Ref. 21

Table 3.12 NDB Specifications

References to Chapter 3.0

1. Aerodrome Standards and Recommended Practices, TP 312E, Transport Canada Air Licencing and Certification Branch, Ottawa, August, 1984.

2. Information Manual 185 Skywagon, Original Issue, July 1983, Cessna Aircraft Company, Wichita, Kansas, U.S.A.

3. Performance Data - Standard Wheelplane - DHC-6 Twin Otter Series 300, Issue 11, November 1983, The DeHavilland Aircraft of Canada Ltd., Downsview, Ontario.

4. Citation II Flight Planning Guide, February 1984, Cessna Aircraft Company, Wichita, Kansas, U.S.A.

5. Construction Cost Reference Data Base for CATA Airport Facilities Vol. 2 Surface Structures and Utilities, TP 3218, Transport Canada, July 1984.

6. "Height Dispersion over Threshold, STOL Demonstration", Rept. No. CPS-76-26, TDC 1976.

7. Utility Airports Air Access to National Transportation Consolidated Reprint Incorporating Changes 1 through 7, A.C. No. 150 15300-48, Federal Aviation Administration, Washington, D.C., June 1975.

8. Country Airport Design Manual, Ohio Department of Transportation, Columbus, Ohio.

9. Letter from R.B. Keinz, Assistant Commissioner, Minnesota Department of Transportation Aeronautics Division dated 31 December, 1984 to R.S. Wallace & Associates Ltd.

10. ATCO Industries (NA) Ltd., Brochures and Price List, ATCO Industries (NA) Ltd. Ottawa, Ont., December 1984.

11. Red Jacket Price List & Brochure, Wylain Can. Ltd., Brampton, Ontario, December 1983.

12. Les Industries Wedco Ltee Price List and Brochures, Les Industries Wedco Ltee, Boucherville, Que., Jan. 1984.

13. Telephone conversation between T. Habicht of R.S. Wallace & Associates Ltd. and T. Hopkins, Instrument Sales Representative at Canadian Marconi Co., Ottawa, Feb. 1985.

14. Lenbrook Industries Ltd. Brochure, Lenbrook Industries Ltd., Scarborough, Ont. 1981.

15. Telephone Conversation between T. Habicht of R.S. Wallace & Associates Ltd. and R. Dacosta of Airborne Electronics Ltd., Toronto, Feb. 1985.

References to Chapter 3.0 (Cont'd.)

16. Motorola Ltd. Brochures, Motorola Ltd., Schammburg, Illinois, 1979 & 80.

17. Telephone Conversation between T. Habicht of R.S. Wallace & Associates Ltd. and M. Hortie, District Sales Manager at Motorola Ltd., Ottawa, Feb. 1985.

18. Maxim Airfield Lighting Catalogue, Maxim Visual Aids Ltd., Bracebridge, Ont.

19. Letter from Maxim Visual Aids Ltd., to R.S. Wallace & Associates Ltd. dated 20 Dec. 1984.

20. Crouse Hinds Lighting Catalogue and Price List, Crouse Hinds Lighting, Granby, Quebec, September 1984.

21. Spilsbury Communications Ltd. Price List and Brochures, Spilsbury Communications Ltd., Vancouver, B.C. 1983.

4.0 AIRCRAFT COST/PERFORMANCE PROFILES

4.1 Aircraft Selected

Three aircraft were chosen for analysis. The aircraft selected are typical/representative of the general aircraft types found in the under 5,675 kg (12,500 lbs) maximum gross takeoff weight (MTOW) category. The aircraft chosen, and the aircraft type each represent, are the following:

(i) single engine piston driven - Cessna 185 Skywagon
(ii) twin engine turboprop - DeHavilland DHC-6 Twin Otter, Series 300
(iii) twin engine jet - Cessna Citation II (6,040 kg (13,300 lbs))

The above aircraft differ widely in cost and performance. Hence, each aircraft offers a unique level of service (for emergency evacuation) within a unique cost range. Descriptions of each aircraft follow:

4.1.1 Cessna 185

A point form description of this aircraft follows:

- o maximum takeoff weight - 1,520 kg (3,350 lbs)
- o flight crew - 1 or 2
- o passenger seating capacity - 4 or 5 (or 1 prone casualty, plus medical attendant).
- o wing span - 11 m (36 ft)
- o overall length - 8.2 m (27 ft)
- o cabin length - 2.3 m (7.5 ft) incl. cockpit
- o cabin floor width - 0.9 m (2.9 ft) max, 0.8 m (2.5 ft) min.
- o engine - one normally-aspirated, direct-drive, air-cooled, horizontally-opposed, fuel-injected, six-cylinder engine.
- o fuel - 100/130 or 100 LL aviation fuel
- o propellor - 3 blade, constant speed, variable pitch
- o maximum speed at sea level - 285 km/hr (154 knots)

Performance data for the aircraft are given in Table 4.1, "Cessna 185 Performance Data". For medical evacuation, the following comprise the aircraft takeoff weight:

o	standard empty weight	795 kg	(1,752 lbs)
o	pilot, medical attendant, casualty	204 kg	(450 lbs)
o	full fuel load	239.5 kg	(528 lbs)
o	medical equipment, say	122.5 kg	(270 lbs)
		1361 kg	(3,000 lbs)

It would be feasible to reduce the allowance for medical equipment and add either one more casualty (seated), co-pilot or medical attendant.

Stage length (km)	Block Time[2] (min.)	Fuel consumed (kg)	Fuel remaining (kg)
93	30.2	22.7	181.4
139	40.6	30.8	173.3
185	50.9	39.9	169.2
232	61.2	45.8	158.3
278	71.6	53.5	150.6
324	81.9	61.2	142.9
371	92.3	69.0	135.2 (3)
463	113.0	83.9	120.2

1. Cruise altitude 1,219 m; standard temperature; 1,361 kg takeoff weight.
2. Includes 12 minutes for start, taxi, takeoff, circuit, landing, taxi-in.
3. Adequate VFR reserves.

Source: Ref. 1

Table 4.1 Cessna 185 Performance Data[1]

Assuming that refuelling facilities would not be available at a typical remote site, it is seen from the above table that the Cessna 185 would provide minimum (one or two casualty; four hour round trip time) medical evacuation service in a 370 km (200 NM) radius from home base. Thus, all remote communities requiring airports (see Chapter 2.0) could be provided with an air medical evacuation service using Cessna 185 aircraft based at two centres. The most likely choices would be Winnipeg for the south and Thompson for the north. Coverage offered from these centres is shown on Figure 4.1, "Cessna 185 Medical Evacuation Coverage - Manitoba".

4.1.2 DHC-6 Twin Otter Series 300

A point form description of this aircraft follows:

- maximum takeoff weight - 5,670 kg (12,500 lbs)
- flight crew - 1 or 2
- passenger seating capacity - 20
- wing span - 19.8 m (65 ft)
- overall length - 15.8 m (51.8 ft)
- cabin length - 5.6 m (18.4 ft)
- cabin floor width - 1.3 m (4.3 ft)
- engines - two Pratt & Whitney Aircraft of Canada Limited PT6A-27, single-stage, free-turbine engines.
- fuel - aviation turbine fuels (JP-1, JP-4), Arctic Diesel Fuel (CPW 46), or in an emergency aviation gasoline may be used, but is restricted to a maximum of 150 hr between engine overhauls.
- maximum speed at sea level - 315 km/hr (170 knots)

Performance data for the aircraft are given in Table 4.2, "DHC-6 Twin Otter Performance Data". For medical evacuation, the following comprise the typical aircraft takeoff weight:

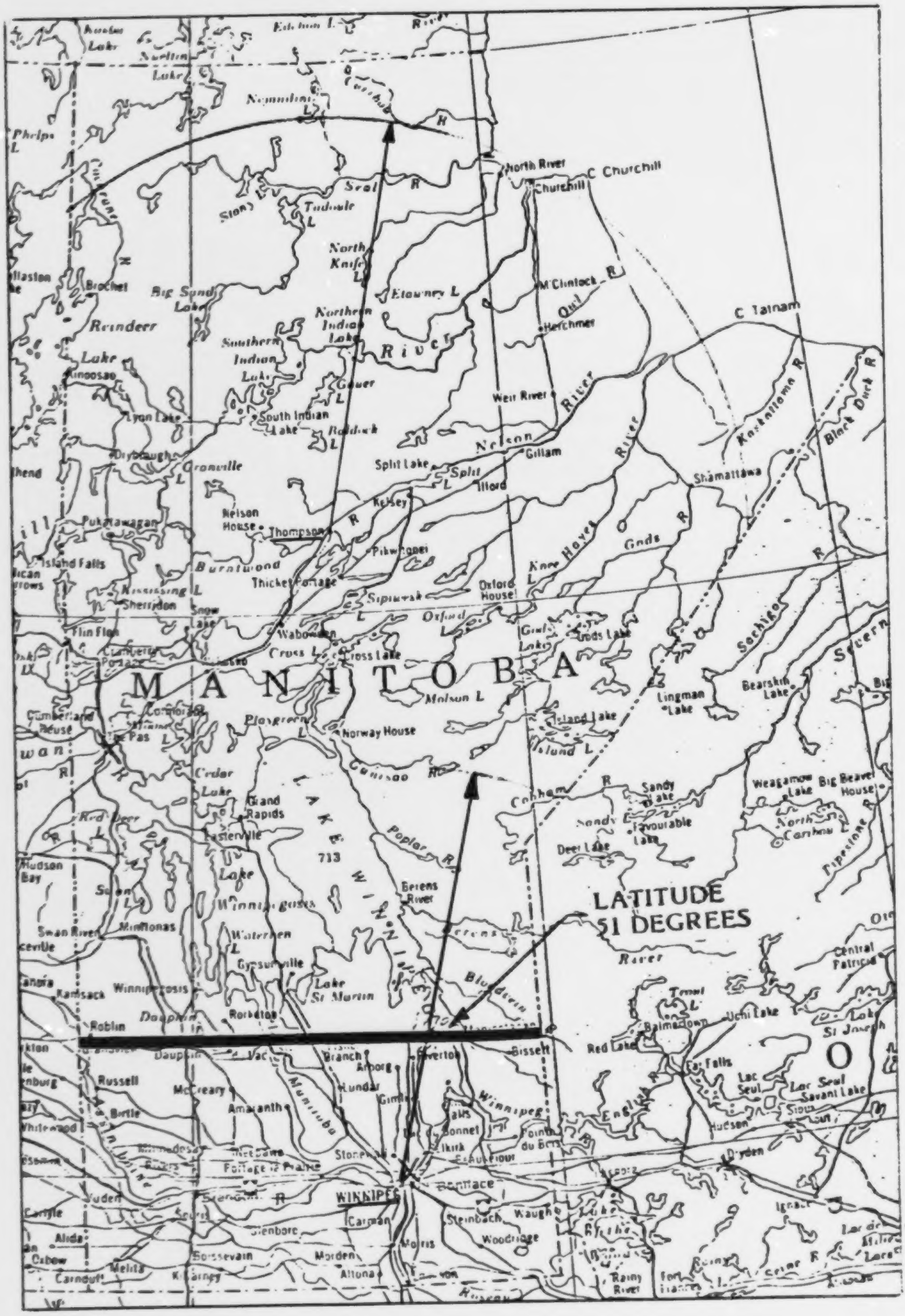

MANITOBA
LATITUDE 51 DEGREES
Churchill
Thompson
Split Lake
Gillam
Norway House
Flin Flon
The Pas
Lake Winnipeg
Winnipeg
Berens River
Bissett
Oxford House
Gods Lake
Island Lake
Red Lake
Dryden
Brandon
Portage la Prairie

Figure 4.1 Cessna 185 Medical Evacuation Coverage - Manitoba

Source: Ref. 2

Stage length (km)	Block Time[2] (min.)	Fuel consumed (kg)	Fuel remaining (kg)
93	24.6	113.3	796.0
139	33.0	154.7	752.5
185	41.3	199.8	709.4
232	49.5	244.0	663.2
278	57.8	285.3	621.9
324	66.0	322.5	584.7
371	74.2	366.5	540.7
463	90.6	450.9	456.3 (3)

1. Cruise altitude (907 - 3,175 m); standard temperature +10° C; 4,536 kg (10,000 lbs) takeoff weight.
2. Includes 7 minutes for taxi-out, takeoff, circuit, landing, taxi-in.
3. Does not cover VFR reserves. Adequate VFR reserves for other stage lengths.

Source: Ref. 3

Table 4.2 DHC-6 Twin Otter Performance Data[1]

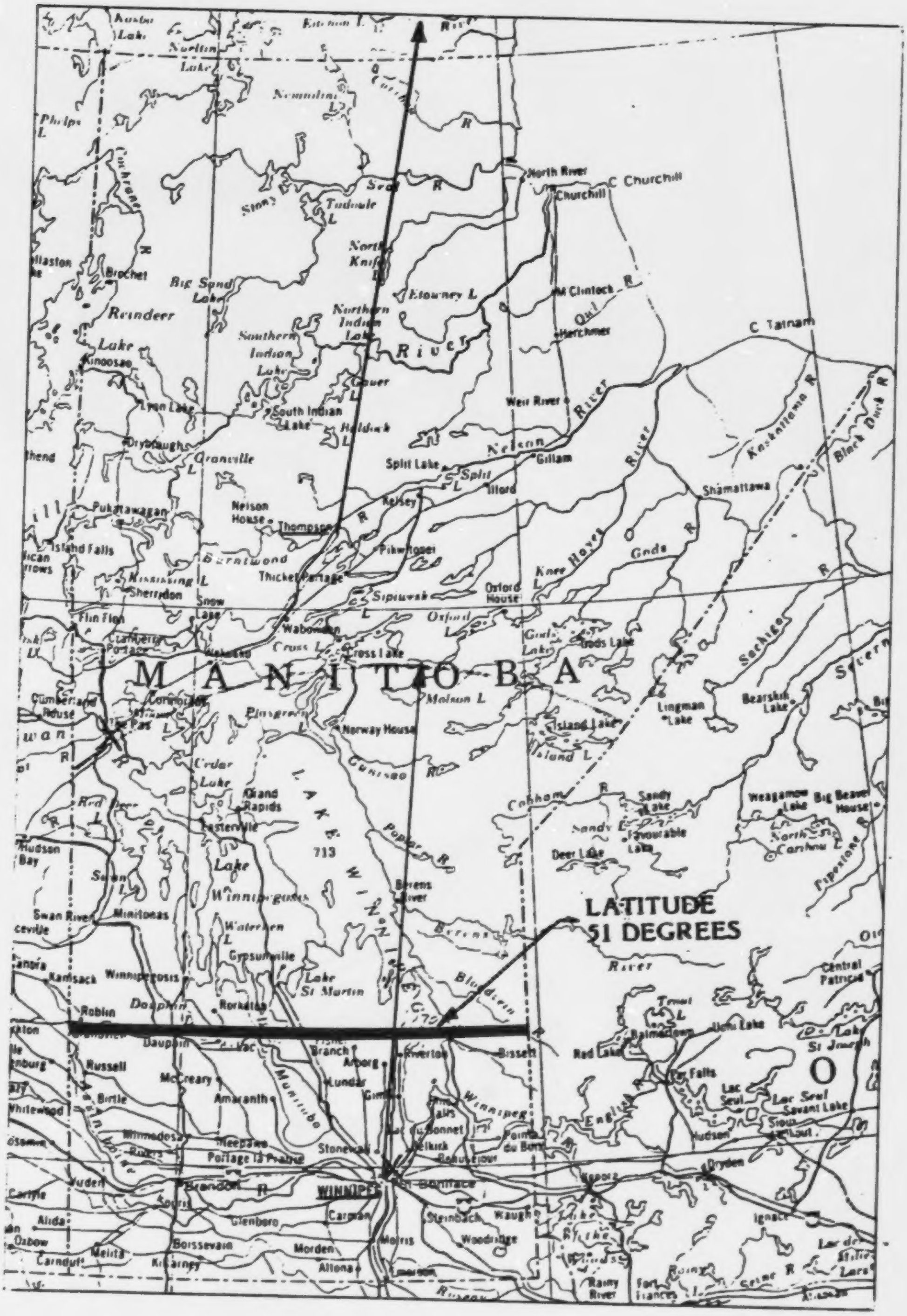
o	standard empty weight	3,238 kg
o	pilot, medical attendant, casualty	204 kg
o	fuel	907 kg
o	medical equipment, say	186 kg
		4,536 kg

More prone casualties could be accommodated (up to four) without compromising the range of the aircraft, within the maximum takeoff weight of 5,670 kg (12,500 lbs).

Again, assuming that refuelling facilities would not be available at remote sites, it is seen from the above Table that the DHC-6 Twin Otter would provide a reasonable level of medical evacuation service in the 460 km (250 NM) range. As per the Cessna 185, complete coverage of remote communities in Manitoba could be provided by operating Twin Otters out of Winnipeg and Thompson. Coverage offered from these two centres is shown in Figure 4.2, "DHC-6 Twin Otter Medical Evacuation Coverage - Manitoba".

4.1.3 Cessna Citation II

The Government of Manitoba has chosen this aircraft to fly medical evacuations, starting in 1985. The aircraft will fly into major northern airports. The Citation II is included in this study to provide an indication of the effects on airport design and hence capital and O&M costs of designing for a high-performance jet aircraft (see Chapter 5.0). A brief point form description of the Citation II follows:



LATITUDE
51 DEGREES
MANITOBA
C Churchill
Churchill
North River
Big Sand Lake
Reindeer Lake
Southern Indian Lake
Northern Indian Lake
South Indian Lake
Lynn Lake
Brochet
Kinoosao
Nelson River
Split Lake
Gillam
Ilford
C Tatnam
Shamattawa
Herchmer
Weir River
Thompson
Nelson House
Pukatawagan
Island Falls
Sherridon
Flin Flon
Snow Lake
Thicket Portage
Pikwitonei
Kelsey
Wabowden
Cross Lake
Oxford House
Gods Lake
Norway House
Island Lake
The Pas
Cumberland House
Cedar Lake
Grand Rapids
Easterville
Lake Winnipegosis
Lake Winnipeg
Berens River
Bloodvein
Swan River
Minitonas
Roblin
Dauphin
Russell
Birtle
McCreary
Amaranth
Riverton
Bissett
Arborg
Lundar
Gimli
Pine Falls
Selkirk
Stonewall
Neepawa
Minnedosa
Portage la Prairie
Brandon
WINNIPEG
St Boniface
Carman
Steinbach
Morris
Morden
Altona
Emerson
Killarney
Boissevain
Melita
Souris
Glenboro
Carnduff
Oxbow
Alida
Kenora
Red Lake
Ear Falls
Balmertown
Dryden
Sioux Lookout
Ignace
Fort Frances
Rainy River
Lac Seul
Sandy Lake
Favourable Lake
Deer Lake
Big Beaver House
Weagamow Lake
Bearskin Lake
Lingman Lake
Central Patricia
O

Figure 4.2 DHC-6 Twin Otter Medical Evacuation Coverage - Manitoba

Source: Ref. 2

- maximum takeoff weight - 6,033 kg (13,300 lbs)
- flight crew - 2
- passenger seating capacity - 10
- wing span - 15.8 m (51.7 ft)
- overall length - 14.4 m (47.2 ft)
- cabin length - 6.4 m (20.9 ft)
- engines - two Pratt and Whitney Aircraft of Canada JT15D-4 turbofans
- maximum speed at sea level - 484 km/hr (262 knots)

The Citation II could provide adequate coverage based out of Winnipeg only, for all identified remote communities. Return flying time (not including administration) to Grandville Lake, (the most distant community identified in this study) from Winnipeg (approximately 500 nautical miles; 930 km) would be roughly three hours. Performance data for the aircraft are given in Table 4.3, "Cessna Citation II Performance Data". For medical evacuation, the following comprise the typical aircraft takeoff weight:

standard empty weight	3,264 kg
pilot, medical attendant, casualty	204 kg
fuel	1,995 kg
medical equipment, say	206 kg
	5,669 kg

Assuming that refuelling facilities would not be available at remote sites, it is seen that the Citation II would provide medical evacuation coverage in the 550 nautical mile range. Coverage provided out of Winnipeg is shown in Figure 4.3, "Cessna Citation II Medical Evacuation Coverage - Manitoba".

4.2 Direct Operating Costs

Direct operating costs (DOC) are developed in this Section for provision of round-the-clock air medical evacuation services by each of the Cessna 185, DHC-6 and Citation II aircraft. Costs for the C-185 and DHC-6 reflect operation of one aircraft based at Winnipeg and one at Thompson; costs for the Citation II reflect operations based at Winnipeg. Costs included are:

(i) flight crew - based on crew of five pilots per aircraft
(ii) fuel - calculated directly from flight profiles
(iii) parts replacement - dependant upon stage length; calculated directly from flight profiles
(iv) maintenance labour - as above
(v) depreciation - based on straight-line method, formula depends upon aircraft type
(vi) insurance - annual premiums vary from 1% (C-185) to 5% (DHC-6; Citation II) of aircraft purchase price.

Stage Length (km)	Block Time[2] (min.)	Fuel Consumed (kg)	Fuel Remaining (kg)
93	17.1	139.3	1,856.6
139	22.1	196.9	1,799.0
185	27.1	254.5	1,741.3
232	27.0	276.7	1,719.1
278	31.0	327.5	1,668.3
324	35.0	378.3	1,617.5
371	39.0	429.1	1,566.7
463	46.4	425.9	1,569.9
556	54.2	505.3	1,490.5
651	62.1	586.5	1,409.3
741	70.0	667.2	1,328.6
834	77.9	748.0	1,247.8
927	85.7	827.8	1,168.0
1,019	93.6	908.6	1,087.3 (3)

1. Cruise altitude 3,048 - 8,841 m (10,000 - 29,000 ft); standard temperatures; 5,670 kg (12,500 lb.) takeoff weight
2. Includes 7 minutes for taxi-out, takoff, circuit, landing, taxi-in.
3. Allows for 30 minutes VFR reserve.

Source: Ref. 4

Table 4.3 Cessna Citation II Performance Data[1]

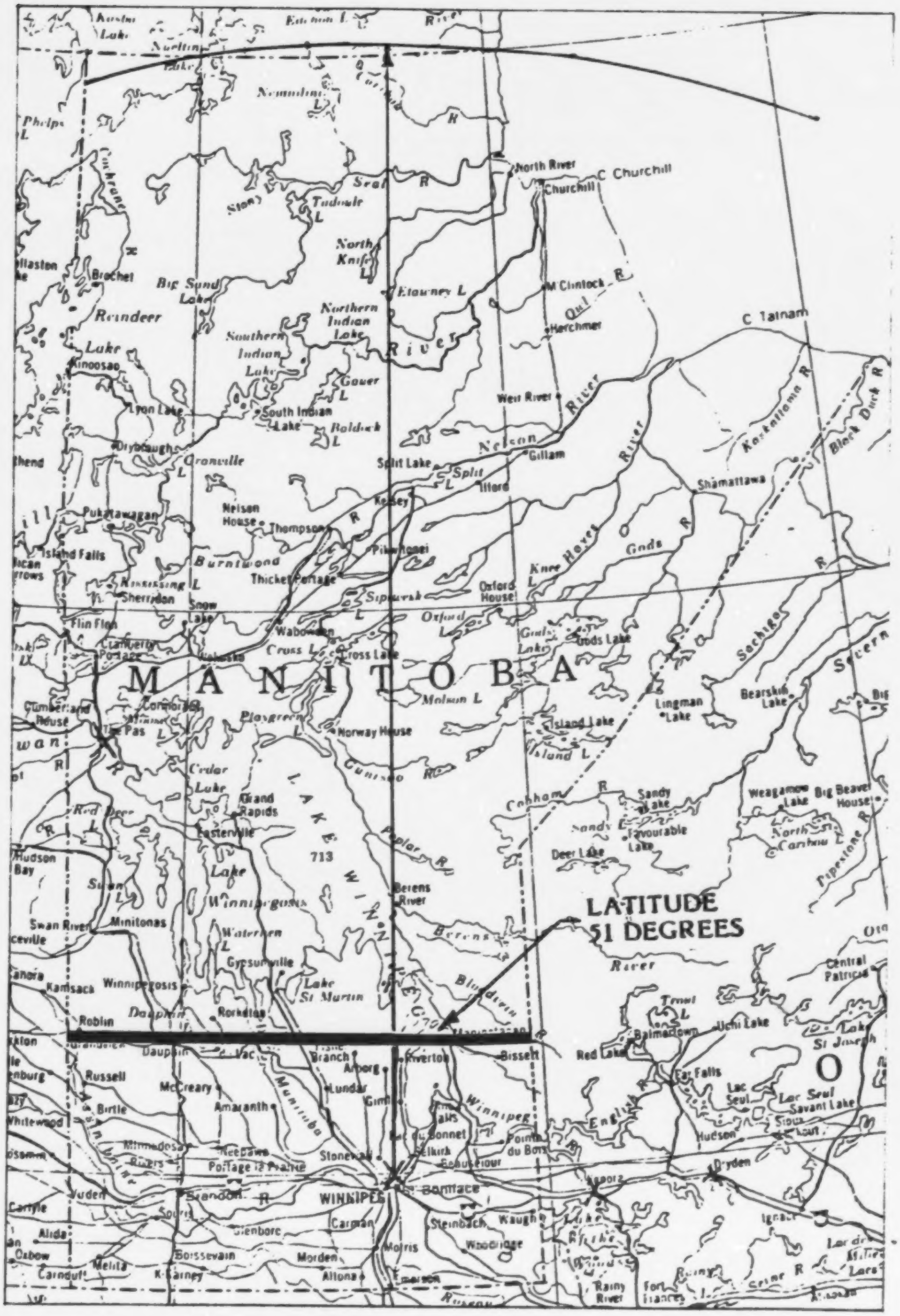

LATITUDE
51 DEGREES
M A N I T O B A
Churchill
C Churchill
North River
M Clintock
Herchmer
C Tatnam
West River
Gillam
Split Lake
Ilford
Shamattawa
Kelsey
Pikwitonei
Thompson
Nelson House
Thicket Portage
Wabowden
Cross Lake
Oxford House
Gods Lake
Norway House
Island Lake
Lingman Lake
Bearskin Lake
Big Beaver House
Weagamow Lake
Sandy Lake
Favourable Lake
Deer Lake
Berens River
Grand Rapids
Easterville
Flin Flon
Sherridon
Snow Lake
Island Falls
Pukatawagan
Lynn Lake
Kinoosao
Brochet
South Indian Lake
The Pas
Cumberland House
Hudson Bay
Swan River
Minitonas
Kamsack
Winnipegosis
Roblin
Dauphin
Gypsumville
Bissett
Riverton
Arborg
Lundar
Gimli
Selkirk
Russell
Birtle
Minnedosa
Neepawa
Portage la Prairie
Stonewall
WINNIPEG
Boniface
Beausejour
Brandon
Souris
Carman
Morris
Morden
Steinbach
Emerson
Boissevain
Melita
Killarney
Kenora
Dryden
Red Lake
Balmertown
Ear Falls
Lac Seul
Hudson
Sioux Lookout
Savant Lake
Central Patricia
Ignace
Rainy River
Fort Frances
Nelson River
Hayes River
Gods R
Lake Winnipeg
Lake Winnipegosis
Lake St Martin
Reindeer Lake
Southern Indian Lake
Northern Indian Lake
Cedar Lake
Playgreen L
Seal R
Churchill R
Severn
Sachigo R
Black Duck R
English R
713

Figure 4.3 Cessna Citation II Medical Evacuation Coverage - Manitoba

Source: Ref. 2

DOC are affected by stage length. Hence, the cost calculations are performed separately for each destination point and aggregated to produce total and average cost per block hour operation time. Cost calculations are presented in the following Tables 4.4, 4.5 and 4.6 "Aircraft Medical Evacuation DOC". The site allocations for the C-185 and DHC-6 are based on a service range of 370.7 km (200 NM), for both aircraft types a 463.3 km (250 NM) range would increase travel times for communities on the perimeter of the Winnipeg service radius. Communities in this range could be served out of Thompson, at roughtly 1/3 the travel time). Provision of direct air medical evacuation services to all remote communities in Manitoba is accounted for.(5) Fixed costs are spread among all communities to provide a best estimate of that portion of total DOC attributable to provision of services to remote communities.

4.3 Comparison with Other Aircraft

The three aircraft chosen for this study are shown in a visual comparison with similar aircraft types in Figure 4.4, "Takeoff Length vs. Maximum Takeoff Weight". This scatter plot shows three aircraft groupings, with two exceptions. Both the DHC-6 (due to its STOL capability) and the Citation II (high thrust to weight ratio) show a minimum airfield length requirement within each group. The consequence of this finding is that, for a given airfield length, location, etc., the DHC-6 and Citation II would be least affected by weight restrictions. These are ideal aircraft for operating into relatively short airfields. The Cessna 182 exhibits similar takeoff length requirements to other aircraft in its class. The complete list of aircraft shown on Figure 4.4 is given in the following Table 4.7:

Aircraft Name	Aircraft Type
Cessna Skywagon II	single engine piston
Mooney 201	single engine piston
Piper Archer II	single engine piston
Piper Saratoga	single engine piston
Cessna Stationair 8	single engine piston
DHC-6-300	twin turboprop
Beech Super King Air B200	twin turboprop
Cessna Conquest II	twin turboprop
Beech King Air F90-1	twin turboprop
Fairchild Merlin IIIC	twin turboprop
Piper Mojave	twin turboprop
Piper Cheyenne IV	twin turboprop
Piper T-1040	twin turboprop
Cessna Citation II	twin turbofan
Gates Learjet 55	twin turbofan
Mitsubishi Diamond 1	twin turbofan
Dassault-Breguet Falcon 100	twin turbofan

Table 4.7 Aircraft Used in Figure 4.4

Source: Ref. 6

Community	Dist (NM)	pop'n	Two Way Trip/Yr	Annual Utilization (bl-hours)	Fuel Cost ($)	Maint Labour ($)	Parts ($)	Subtotals	Share of Fixed Cost	Totals	DOC/ bl-hr.
Poplar River 16	183	544	10.9	33.5	$1,144.40	$334.74	$502.11	$1,981.26	$2,046.80	$4,028.06	$120.33
Berens River 13	146	770	15.4	36.8	$1,257.50	$367.55	$551.32	$2,176.37	$2,897.13	$5,073.49	$138.04
Bloodvein River 12	108	417	8.3	17.0	$582.90	$170.14	$240.27	$1,093.31	$1,568.96	$2,662.27	$156.48
Matheson Island	113	128	2.6	5.2	$178.92	$52.22	$104.45	$335.60	$481.60	$817.20	$156.48
Paunigassi	140	266	5.3	12.7	$434.41	$126.97	$190.46	$751.84	$1,000.83	$1,752.66	$138.04
Dauphin River 48A	124	97	1.9	4.0	$135.59	$39.56	$79.15	$254.32	$364.96	$619.28	$156.48
Jackhead 43	119	199	4.0	8.1	$270.17	$81.19	$162.38	$521.75	$748.74	$1,270.46	$156.48
Pelican Rapids	205	236	4.7	17.8	$604.25	$177.79	$266.68	$1,048.72	$887.95	$1,936.67	$108.93
Pine Dock	103	105	2.1	4.3	$146.77	$42.84	$85.68	$275.29	$395.06	$670.36	$156.48
The Narrows 49	119	452	9.0	18.4	$631.82	$184.42	$368.83	$1,185.07	$1,700.65	$2,885.72	$156.48
TOTAL	1360	3214	64.3	157.7	$5,394.75	$1,577.43	$2,651.34	$9,623.51	$12,092.68	$21,716.19	
AVG	136.0	321.4	6.4	15.8							$137.67

Fixed Cost

Depreciation	$19,000.00
Crew (5 pilots @ $25,000)	$125,000.00
Insurance	$6,500.00
Total	$150,500.00

Cessna 185 - Based at Thompson

Community	Dist (NM)	pop'n	Two Way Trip/Yr	Annual Utilization (bl-hours)	Fuel Cost ($)	Maint Labour ($)	Parts ($)	Subtotals	Share of Fixed Cost	Totals	DOC/ bl-hr.
God's Lake 23	135	892	17.6	42.6	$1,515.69	$425.78	$638.67	$2,580.14	$3,835.60	$6,415.74	$150.68
God's River	135	253	5.1	12.1	$429.70	$120.77	$181.15	$731.31	$1,087.90	$1,819.71	$150.66
Red Sucker Lake	173	327	6.5	17.9	$635.69	$178.54	$267.81	$1,082.04	$1,406.10	$2,488.14	$139.36
S. Indian Lake	70	842	16.8	28.6	$1,066.98	$285.72	$571.44	$1,924.14	$3,620.60	$5,544.74	$194.06
Ilford	76	190	3.8	6.4	$240.77	$64.47	$128.95	$434.19	$817.00	$1,251.19	$194.06
Shamattawa 1	189	522	10.4	32.1	$1,142.55	$321.20	$481.81	$1,945.56	$2,244.60	$4,190.16	$130.45
Thicket Portage	32	198	4.0	4.0	$142.56	$39.86	$79.73	$262.15	$851.40	$1,113.55	$279.34
Split Lake 171	59	1036	20.7	35.2	$1,312.82	$351.55	$703.10	$2,367.47	$4,454.80	$6,822.27	$194.06
Sherridon	119	167	3.3	6.8	$242.88	$68.14	$136.27	$447.29	$718.10	$1,165.39	$171.04
Wassagomach	150	660	13.2	36.0	$1,283.04	$360.36	$540.54	$2,183.94	$2,838.00	$5,021.94	$139.36
Granville Lake	151	90	1.8	4.9	$174.96	$49.14	$73.71	$297.81	$387.00	$684.81	$139.36
Wabowden	59	650	13.0	22.1	$823.68	$220.57	$441.13	$1,485.38	$2,795.00	$4,280.38	$194.06
Tadoule Lake	124	250	5.0	10.2	$363.60	$102.00	$204.00	$669.60	$1,075.00	$1,744.60	$171.04
TOTAL	1472	6077	121.5	258.8	$9,375.12	$2,586.10	$4,448.31	$16,411.53	$26,131.10	$42,542.63	
AVG	113.2	467.5	9.3	19.9							$164.38

Fixed Cost

Depreciation	$19,000.00
Crew (5 pilots @ $25000)	$125,000.00
Insurance	$6,500.00
Total	$150,500.00

Table 4.4 **Aircraft Medical Evacuation Annual DOC**
Cessna 185 - Based at Winnipeg

Source: Ref.4; R.S. Wallace & Associates Ltd.

Community	Dist (NM)	pop'n	Two Way Trip/Yr	Annual Utilization (bl-hours)	Fuel Cost ($)	Maint Labour ($)	Parts ($)	Subtotals	Share of Fixed Cost	Totals	DOC/ bl-hr.
Poplar River 16	193	544	16.9	26.8	$4,447.74	$403.56	$1,652.98	$6,504.29	$7,044.80	$13,549.09	$504.86
Berens River 13	146	770	15.4	28.7	$4,946.48	$431.20	$1,927.75	$7,305.43	$9,971.50	$17,276.93	$601.01
Bloodvein River 12	108	417	8.3	13.1	$2,191.75	$195.99	$923.64	$3,311.38	$5,400.15	$8,711.53	$666.73
Matheson Island	113	128	2.6	4.0	$672.77	$60.16	$283.51	$1,016.44	$1,657.60	$2,674.04	$666.73
Fauni gassi	140	266	5.3	9.9	$1,708.78	$148.96	$665.95	$2,523.69	$3,444.70	$5,968.39	$601.01
Dauphin River 48A	124	97	1.9	3.0	$509.83	$45.59	$214.85	$770.27	$1,256.15	$2,026.42	$666.73
Jackhead 43	119	199	4.0	6.2	$1,045.94	$93.53	$440.78	$1,580.25	$2,577.05	$4,157.30	$666.73
Pelican Rapids	205	236	4.7	13.8	$2,460.83	$207.65	$828.09	$3,516.60	$3,056.20	$6,572.80	$474.73
Pine Dock	103	105	2.1	3.3	$551.88	$49.35	$232.57	$833.80	$1,359.75	$2,193.55	$666.73
The Narrows 49	119	452	9.0	14.2	$2,275.71	$212.44	$1,101.16	$3,589.31	$5,853.40	$9,442.71	$666.73
TOTAL	1360	3214	64.3	123.2	$20,931.73	$1,847.46	$8,172.28	$30,951.47	$41,621.30	$72,572.77	
AVG	136.0	321.4	6.4	12.3							$539.24

Fixed Costs

Depreciation	$365,000.00
Crew (4 pilots @ $32,000)	$128,000.00
Insurance	$25,000.00
Total	$518,000.00

DHC-6 - Based at Thompson

Community	Dist (NM)	pop n	Two Way Trip/Yr	Annual Utilization (bl-hours	Fuel Cost ($)	Maint Labour ($)	Parts ($)	Subtotals	Share of Fixed Cost	Totals	DOC/ bl-hr.
God's Lake 22	135	892	17.8	33.3	$6,103.06	$499.52	$2,233.19	$8,835.77	$13,201.60	$22,037.37	$661.76
God's River	135	253	5.1	9.4	$1,731.03	$141.68	$633.40	$2,506.11	$3,744.40	$6,250.51	$661.76
Red Sucker Lake	173	327	6.5	14.2	$2,440.73	$212.55	$911.84	$3,565.12	$4,839.60	$8,404.72	$593.13
S. Indian Lake	70	842	16.8	15.2	$2,618.62	$246.29	$1,236.12	$4,101.03	$12,461.60	$16,562.63	$1,092.81
Ilford	76	190	3.8	4.7	$827.26	$76.16	$356.80	$1,260.21	$2,812.00	$4,072.21	$868.89
Shamattawa 1	189	522	10.4	25.6	$4,545.56	$386.28	$1,387.10	$6,318.95	$7,725.60	$14,244.55	$553.14
Thicket Portage	32	198	4.0	2.6	$369.47	$46.20	$244.02	$659.68	$2,930.40	$3,590.08	$1,359.88
Split Lake 171	59	1036	20.7	18.6	$3,221.96	$303.03	$1,520.93	$5,045.92	$15,332.80	$20,378.72	$1,092.81
Sherridon	119	167	3.3	5.2	$934.87	$78.49	$369.90	$1,383.25	$2,471.60	$3,854.85	$736.69
Wassagomach	150	660	13.2	28.6	$4,926.24	$429.00	$1,840.41	$7,195.65	$9,768.00	$16,963.65	$593.13
Grandville Lake	151	90	1.8	3.9	$671.76	$58.50	$250.97	$981.23	$1,332.00	$2,313.23	$593.13
Wabowden	59	650	13.0	11.7	$2,021.50	$190.13	$954.25	$3,165.88	$9,620.00	$12,785.88	$1,092.81
Tadoule Lake	124	250	5.0	7.8	$1,399.50	$117.50	$553.74	$2,070.74	$3,700.00	$5,770.74	$736.69
TOTAL	1472	6077	121.5	181.1	$31,811.57	$2,785.32	$12,692.65	$47,289.54	$89,939.60	$137,229.14	
AVG	113.2	467.5	9.3	13.9							$757.90

Fixed Cost

Depreciation	$365,000.00
Crew (4 pilots @ $32,000)	$128,000.00
Insurance	$25,000.00
Total	$518,000.00

Table 4.5 Aircraft Medical Evacuation Annual DOC
DHC-6 - Based at Winnipeg

Source: Ref.4; R.S. Wallace & Associates Ltd.

Community		Dist (NM)	pop'n	Two Way Trip/Yr	Annual Utilization (bl-hours)	Fuel Cost ($)	Maint Labour ($)	Parts ($)	Share of Fixed Cost	Totals	DOC/bl-hr
Poplar River 16		183	544	10.9	12.7	$4,956.06	$2,216.11	$4,432.91	$5,516.65	[illegible]	$1,351.51
Berens River 13		146	770	15.4	14.4	$5,935.78	$2,569.42	$5,018.60	$7,864.27	[illegible]	[illegible]
Bloodvein River 12		108	417	6.3	7.6	$2,922.34	[illegible]	$2,426.66	$4,259.96	[illegible]	$1,557.03
Matheson Island		113	128	2.6	2.1	$897.02	$372.46	$744.87	$1,307.31	$3,321.65	$1,557.03
Paunigassi		140	266	5.3	5.0	$2,050.54	$866.89	$1,733.70	$2,716.75	$7,367.87	$1,483.86
Dauphin River 48A		124	97	1.9	1.6	$679.78	$282.25	$564.48	$990.69	$2,517.20	$1,557.03
Jackhead 43		119	199	4.0	3.3	$1,394.59	$579.05	$1,158.05	$2,032.45	$5,164.14	$1,557.03
Pelican Rapids		205	226	4.7	6.6	$2,563.53	$1,153.68	$2,307.25	$2,410.35	$8,434.80	$1,276.45
Pine Dock		103	[illegible]	[illegible]	1.8	$735.24	$305.53	$611.07	$1,672.40	[illegible]	$1,557.03
The Narrows 49		119	[illegible]	[illegible]	7.5	$3,167.62	$1,315.23	$2,630.34	$4,616.43	$11,729.62	[illegible]
SUBTOTALS	Total	[illegible]	3214	64.26	61.9	$25,303.08	$10,514.01	$21,626.99	$32,525.45	$90,569.71	
	Avg	136	321.4	6.429	6.2						$1,497.83

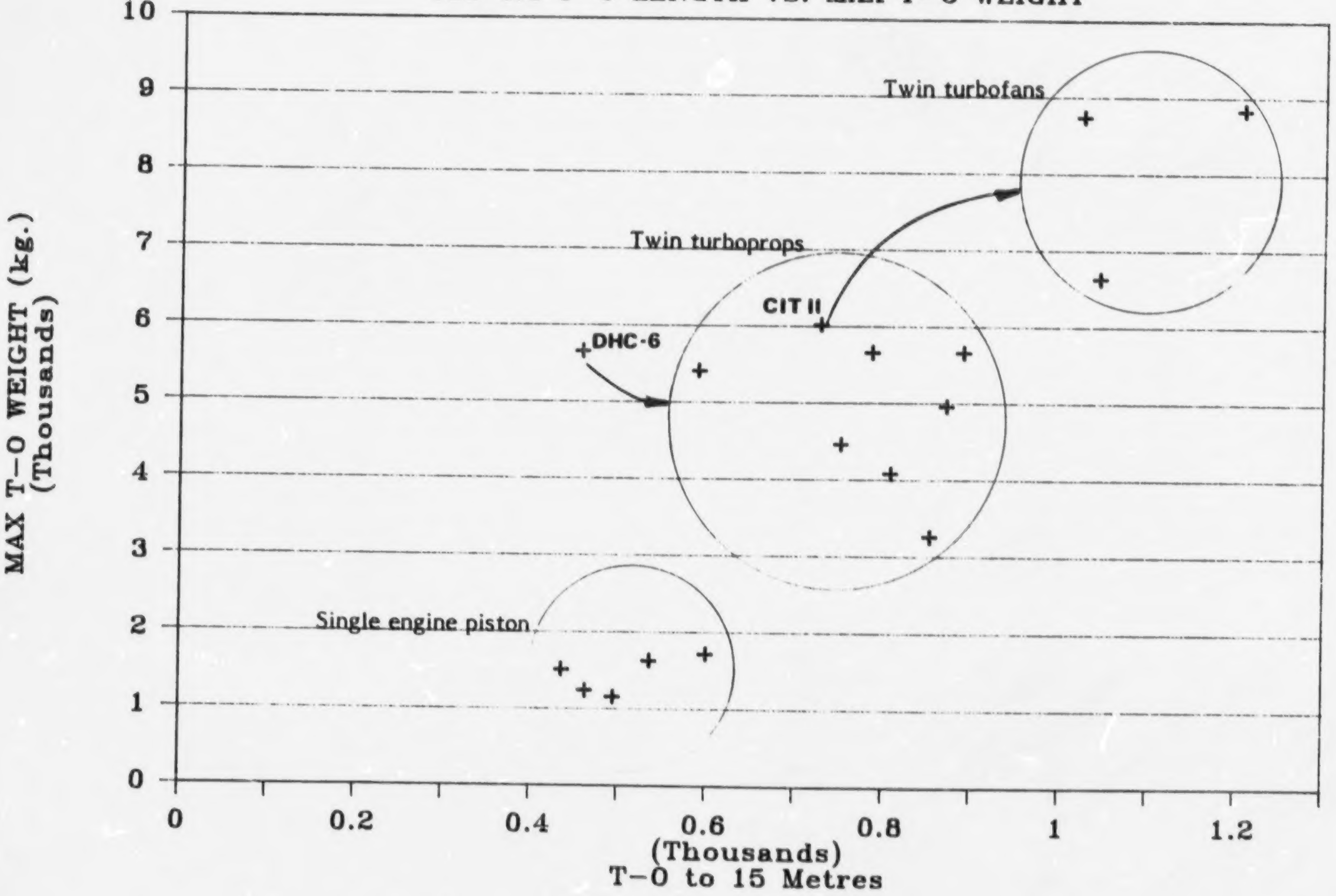
Community		Dist (NM)	pop'n	Two Way Trip/Yr	Annual Utilization (bl-hours)	Fuel Cost ($)	Maint Labour ($)	Parts ($)	Share of Fixed Cost	Totals	DOC/bl-hr
God's Lake 23		232	892	17.8	25.0	$9,689.26	$4,360.52	$8,720.62	$9,110.29	$31,880.69	$1,276.45
God's River		265	253	5.1	8.6	$3,161.89	$1,501.81	$3,003.48	$2,562.97	$10,251.15	$1,191.72
Red Sucker Lake		238	327	6.5	9.2	$3,552.00	$1,598.53	$3,196.91	$3,339.76	$11,687.21	$1,276.45
S. Indian Lake		410	842	16.8	43.2	$14,555.15	$7,546.18	$15,091.63	$8,599.63	$45,792.58	$1,059.46
Ilford		362	190	3.8	8.5	$2,995.92	$1,481.67	$2,963.21	$1,940.53	$9,381.33	$1,105.42
Shamattawa 1		351	522	10.4	23.3	$8,230.90	$4,070.70	$8,141.02	$5,331.36	$25,773.98	$1,105.42
Thicket Portage		324	198	4.0	5.7	$2,775.17	$1,336.65	$2,673.17	$2,022.24	$8,807.23	$1,150.77
Split Lake 171		362	1036	20.7	46.3	$16,335.65	$8,075.02	$16,157.27	$10,581.01	$51,152.95	$1,105.42
Sherridon		335	157	[illegible]	6.5	$2,340.67	$1,127.78	$2,254.64	$1,705.63	$7,428.32	$1,150.77
Wasagomach		243	660	13.2	18.5	$7,169.18	$3,226.39	$6,452.48	$6,740.80	$23,588.86	$1,276.45
Granville Lake		491	90	1.6	5.1	$1,702.94	$890.40	$1,780.72	$919.20	$5,293.26	$1,037.89
Wabowden		297	659	13.0	22.1	$8,123.44	$3,853.40	$7,716.44	$6,638.67	$26,336.95	$1,191.72
Tadoule Lake		475	250	5.0	14.2	$4,730.40	$2,473.34	$4,946.44	$2,553.33	$14,703.50	$1,037.99
SUBTOTALS	Total	4385	6077	121.54	238.0	$85,362.58	$41,550.99	$83,098.02	$62,066.43	$272,078.02	
	Avg	337.3	467.5	9.3	18.3						$1,151.16
GRAND TOTAL	Total	5745	9291	185.80	299.9	$110,665.66	$52,065.00	$104,725.00	$94,592.05	$362,647.74	
	Avg	249.8	404.0	8.1	13.0						$1,209.09

Fixed Cost (system wide)	
5 pilots @ $40,000	$200,000.00
Depreciation	$530,000.00
Insurance	$36,000.00
	$766,000.00

Source: Ref.4; R.S. Wallace & Associates Ltd.

Table 4.6 Aircraft Medical Evacuation Annual DOC Citation II - Based at Winnipeg

FIG 4.4 T–O LENGTH VS. MAX T–O WEIGHT



Source: R.S. Wallace & Associates Ltd.

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5.0 AIRPORT/AIRCRAFT COMBINATIONS

5.1 Generation of Alternatives

In this Chapter alternatives combining aircraft types with airport operations scenarios are presented. As selected in Section 4.1, the aircraft families considered are those represented by the Cessna 185 Skywagon, the DCH-6 Twin Otter and the Cessna Citation. The airport operations scenarios are day visual meteorological conditions (VMC) and night VMC. Day VMC restricts the operations to daylight hours with meteorological conditions such that visibility and height of cloud are greater than or equal to specified minima. The scenarios with night operations have no restriction with respect to time of day since lighting is provided.

Required minimum airfield dimensions are determined by a number of variables including: aircraft type; aircraft GTOW; aircraft operating configuration (STOL or non-STOL); airfield elevation; airfield reference temperature. Table 5.1, "Runway Dimensions" shows minimum runway dimensions as a function of the above five variables. Runway dimensions are based on a hard pavement type.

From Table 5.1, it is seen that minimum runway length is not necessarily a function of aircraft size; the 1,496.9 kg (3,300 lbs) GTOW Cessna 185 requires a runway approximately 30% longer than that required for the DHC-6. This occurs because the DHC-6 can utilize its STOL capabilities to operate out of short airfields. Decreasing runway length will, of course, reduce construction costs. However, use of STOL aircraft will increase aircraft O&M costs.

Certain other airfield dimensions (strip width, graded area width, etc.) are given in Table 5.2, "Airfield Dimensions". These airfield components have been discussed in Section 3.0.

Aircraft Type	Runway Width (m)	Graded Area Width (m)	Strip Width (m)	Taxiway Width (m)
C-185	15.2	38	60	7.5
DHC-6	15.2	38	60	7.5
Cit II	18.0	38	60	10.5

Table 5.2 Airfield Dimensions

Source: Ref. 4; R.S. Wallace & Associates Ltd.

All alternatives will have an identical ATB, water supply system, sewage disposal, power generation, and communications (ground-to-air and overland). Airfield lighting and navigational aids are all common, regardless of aircraft type. These are:

Aircraft Type	Operating Configuration	GTOW (kg)	Airfield Elevation (m)	Airfield Temp. (°C)	Runway Length (m)
C-185	non-STOL	1,360.8	300	22	387
C-185	non-STOL	1,519.5	300	22	503
C-185	non-STOL	1,360.8	0	15	338
C-185	non-STOL	1,519.5	0	15	436
C-185	non-STOL	1,360.8	0	-18	267
C-185	non-STOL	1,519.5	0	-18	340
DHC-6	non-STOL	4,535.9	300	22	297
DHC-6	non-STOL	5,669.9	300	22	485
DHC-6	non-STOL	4,535.9	0	15	268
DHC-6	non-STOL	5,669.9	0	15	439
DHC-6	non-STOL	4,535.9	0	-18	219
DHC-6	non-STOL	5,669.9	0	-18	396
DHC-6	STOL	4,535.9	300	22	259
DHC-6	STOL	5,669.9	300	22	396
DHC-6	STOL	4,535.9	0	15	235
DHC-6	STOL	5,669.9	0	15	366
DHC-6	STOL	4,535.9	0	-18	204
DHC-6	STOL	5,669.9	0	-18	320
Cit-II	non-STOL	4,989.5	300	22	734
Cit-II	non-STOL	4,989.5	0	15	633

Table 5.1 Runway Dimensions

Source: Ref. 1,2,3

i) PAPI (one end)
ii) REIL (one end)
iii) rotating beacon
iv) illuminated wind indicator
v) medium intensity edge lighting
vi) apron floodlighting
vii) low intensity approach lighting (optional)

Mobile equipment required for a given airport layout is also common, and consists of:

i) 1/2 ton pickup truck
ii) 5 ton truck
iii) tractor-loader
iv) attachments (snow plow, flail mower, etc.)

All of the above items are costed separately in the tables given in Appendix G.

5.2 Capital, Operating and Maintenance Costs

The capital costs given in this Section demonstrate the difference in runway construction costs resulting from different design standards (costing for all airport components is given in Appendix G).

Runway construction costs (including: clearing; stumping and grubbing; grading; placement of Granular A) are reported for four runway length requirements (with both full- and reduced-strength sections), plus a standard TC-type design, in Table 5.3, "Typical Runway Construction Costs". The runway length requirements correspond to an airfield elevation and temperature of 300 metres and 22°C respectively. The costs do not include a remoteness factor.

	Design Parameters	Runway Length (m)	Runway Construction Cost (1985)
1.	DHC-6; STOL; 12,500 lb. GTOW	403	$ 262,545
2.	DHC-6; non-STOL; 12,500 lb. GTOW	494	$ 306,075
3.	C-185; non-STOL; 3,350 lb. GTOW	525	$ 320,990
4.	Cit.-II; non-STOL; 11,000 lb. GTOW	785	$ 455,165
5.	Standard 3,000 ft. x 75 ft.	930	$ 689,950

Table 5.3 **Typical Runway Construction Costs (Gravel)**

Source: Ref. 1,2,3,4, R.S. Wallace & Associates Ltd.

Considerable construction cost differences occur when reduced-length/reduced-strength designs are used as opposed to a standard-length/full-strength design. The runway construction costs for items 1 to 4 in Table 5.3 range from 40% to 65% of the cost for the standard runway.

Information regarding operating and maintenance (O&M) costs for small airports was scarce. O&M costs for a typical minimum-standard airport were estimated starting with a baseline cost of $10,000 for runway maintenance(5), and factoring up to include all airfield surfaces, buildings, equipment and the access road. It is anticipated that the access road will be one of few (if any) roads serving the typical remote community, hence the airport equipment will be used to maintain the road. Final estimates for annual O&M cost are $45,000 (gravel, aggregate turf, paving block surfaces) and $40,000 (hard surfaces). All construction, O&M and equipment costs are given for each airport alternative in the Tables of Appendix G.

References to Chapter 5.0

1. Information Manual 185 Skywagon, Original Issue, July 1983, Cessna Aircraft Company, Wichita, Kansas, U.S.A.

2. Performance Data - Standard Wheelplane - DHC-6 Twin Otter Series 300, Issue 11, November 1983, The DeHavilland Aircraft of Canada Ltd., Downsview, Ontario.

3. Citation II Flight Planning Guide, February 1984, Cessna Aircraft Company, Wichita, Kansas, U.S.A.

4. Aerodrome Standards and Recommended Practices, TP312E, Transport Canada Air Licencing and Certification Branch, Ottawa, August, 1984.

5. Interview between Consultant and Mr. D.O. Selby, Manitoba Dept. of Highways and Transportation, Winnipeg, Manitoba, March 21, 1985.

6.0 AIR TRAVEL DEMAND

Demand for air passenger travel in the North is influenced by a number of factors. Some examples affecting the need for air travel are: the presence of alternative access, such as a road; an alternative transport mode, such as rail; the level of community employment and income; urgency, such as a life threatening injury or illness; the level of business and government activity in the area and the community population size, including the surrounding catchment area.

Air services can be divided into several categories, e.g. unit toll air services, charter air services, government including military transport and local and private air activity. Within these categories, emergency medical evacuation can take place either under a charter agreement, or through dedicated aircraft.

The demand for normal commercial air services can be divided on the basis of trip purpose. Air passenger surveys conducted by the Ontario Ministry of Transportation and Communications in 1975, revealed that the split in transportation demand between business and personal was approximately 80/20 on the government-owned norOntair service in Northern Ontario; their survey of all airlines revealed a 70/30 split between business and personal.(1) Trip purpose data for remote communities was not available; hence, the Northern Ontario survey findings (80/20) will be used here as a proxy for the actual trip purpose split.

The following discussion and estimation of air passenger demand for remote communities is divided between normal air travel and emergency aeromedical transport.

6.1 Normal Air Travel Demand for Remote Communities

The Government of Manitoba owns and operates twenty airports in the northern part of Manitoba. A description of the community population and airport activity for each of these airports is shown in Table 6.1, "Activity Summary of Manitoba Owned/Operated Airports".(2)(3) This table provides detailed descriptions of the number of aircraft movements. Although the latter statistic includes passengers in transit, the Manitoba airport authorities advise that in transit traffic is nominal.(4) Hence, the arriving and departing (A&D) passenger figures will be used here as indicative of the air passenger demand for remote communities.

Dividing total passengers by the total population (Table 6.1) yields an annual ratio of 6.94:1.0. The annual aircraft movement/population ratio equals 3.02:1.00. Air cargo demand yields a kg to population ratio of 528.0:1.0. Given the high variability of the data, linear regressions were run to establish a more reliable prediction of demand for new remote airports, as follows:

P = 646.0 + 6.235493 (Population)
M = 537.1 + 2.430 (Population)
C = 28,383.1 + 422.767 (Population)
where:
P = Predicted air passengers per year
M = Predicted aircraft movements per year
C = Predicted kilograms of cargo per year

TABLE 6.1

ACTIVITY SUMMARY YEAR END SUMMARY 1983/84
OF MANITOBA OWNED/OPERATED AIRPORTS

AIRPORT	POPULATION	AIRCRAFT MOVEMENTS AT AIRPORTS SCHEDULED	OTHER COMMERCIAL	PRIVATE & LOCAL	GOVT INCL. MILITARY	TOTAL	TOTAL UNDER 5625 Kg	TOTAL OVER 5625 Kg	PASSENGERS ARRIVING & DEPARTING	Kg CARGO (100Lb=45Kg)	TOTAL SEA/SKI AIRCRAFT MOVEMENTS
1 BERENS RIVER	996	1208	2740	335	226	4509	4469	40	7172	59285	209
2 BLOODVEIN	417	1299	799	4	162	2264	2264	0	7355	34240	270
3 BROCHET	553	931	1085	26	128	2170	645	1525	5816	668150	262
4 CROSS LAKE	2357	2110	759	36	198	3103	2507	596	7989	104722	128
5 GOD'S LK. NARR.	1002	1680	1960	76	441	4157	1894	2263	10826	641630	1301
6 ILFORD	190	142	370	9	72	593	445	148	632	0	0
7 ISLAND LAKE	2317	3779	6464	290	321	10854	7310	3544	23297	1778984	6119
8 LAC BROCHET	370	584	884	28	42	1538	564	974	3032	1265450	282
9 LITTLE GR.RAPIDS	649	958	1045	184	235	2422	2175	247	4444	265722	2350
10 NORWAY HOUSE	2859	1870	2923	531	624	5948	4494	1454	16541	888644	2002
11 OXFORD HOUSE	1070	1052	1433	64	174	2723	2159	564	6383	555055	430
12 PIKWITONEI	201	100	497	10	418	1025	821	204	1555	64616	0
13 POPLAR RIVER	544	1070	805	8	89	1972	1972	0	3217	30910	26
14 PUKATAWAGAN	1134	166	413	6	70	655	445	210	1088	41820	0
15 RED SUCKER LK.	367	664	1051	4	18	1737	1273	464	3417	321395	1492
16 ST THERESA PT.	1320	1522	1872	31	10	3435	1492	1943	8795	846490	202
17 SHAMATTAWA	522	324	1255	49	130	1758	415	1343	4048	1706593	0
18 SOUTH INDIAN L.	842	284	967	162	230	1643	1548	95	2768	272795	340
19 THICKET PORTAGE	198	15	109	13	100	237	237	0	907	2663	5
20 YORK LANDING	320	366	1174	0	72	1612	1198	414	2265	74430.5	60
YEAR END TOTALS	18228	20124	28605	1866	3760	54355	39327	16028	122047	9623794.5	15478

Source: Statistics Canada Aviation Statistical Centre for Aviation Activity, and Manitoba Dept. of Highways and Transportation for Population Estimates.

The coefficients of correlation for the above equations were $R_p = 0.812436$ $R_m = 0.767$ and $R_c = 0.649$. Graphs of the data points are shown in Figures 6.1, 6.2 and 6.3, "Manitoba Remote Population vs. Arriving and Departing Passengers", "Remote Population vs. Total Aircraft Movements" and "Manitoba Remote Population vs. Cargo KG". Extreme data points were deleted in the linear regression for cargo to achieve an acceptable R value. Details concerning the regression analysis are presented in Appendix B.

Since virtually all of the airports in Table 6.1 have no year-round surface access to affect air service demand, the chief remaining demand variable is income. A regression of community income against passenger traffic yielded lower R values than population alone. Hence, income was not included in the above demand formulae.

As population size approaches zero, the above demand equations become less meaningful. It is suggested that, for populations of less than 150, average ratios per capita of 6.94 (passengers), 3.02 (aircraft movements) and 527.97 (kg cargo) be employed to predict air activity.

Assuming that the typical remote community has a population of 400, using the above formulae would yield the following prediction of airport activity:

$$\begin{aligned} P &= 646.0 + (6.235493)(400) \\ &= 3140.0 \text{ passengers per year} \\ M &= 537.1 + (2.43)(400) \\ &= 1509.1 \text{ aircraft movements per year} \\ C &= 28{,}383.1 + (422.767)(400) \\ &= 197{,}489.9 \text{ kg of cargo per year} \end{aligned}$$

The annual passenger figures could be further broken down by trip purpose:

Business/Government =	2,512.0
Personal =	628.0
	3140.0

6.2 Emergency Aeromedical Transport Demand

A certain percentage of the population in a remote community or any community will become ill or injured and require hospitalization. Approximately 14 percent of the Canadian population is hospitalized each year.(5) A review of the hospitalization rates per 100,000 population for injuries and illnesses of an urgent nature revealed a rate of 2304 hospitalizations per 100,000 population per year. (See Appendix C.)

Hospital morbidity data is not available for the Indian/Inuit population which tends to predominate remote communities. The mortality rate for Indian/Inuit communities is higher at 9.5 deaths per thousand population(6) than the Canadian average at 7.1(7); 35 to 40 percent of these Indian/Inuit deaths are due to accidents, poisonings and violence.(7) A certain portion of these deaths would be preventable through air ambulance evacuation (see Chapter 7.0 for further discussion).

FIGURE 6.1

MAN. REMOTE POP VS ARR & DEP PASSENGERS

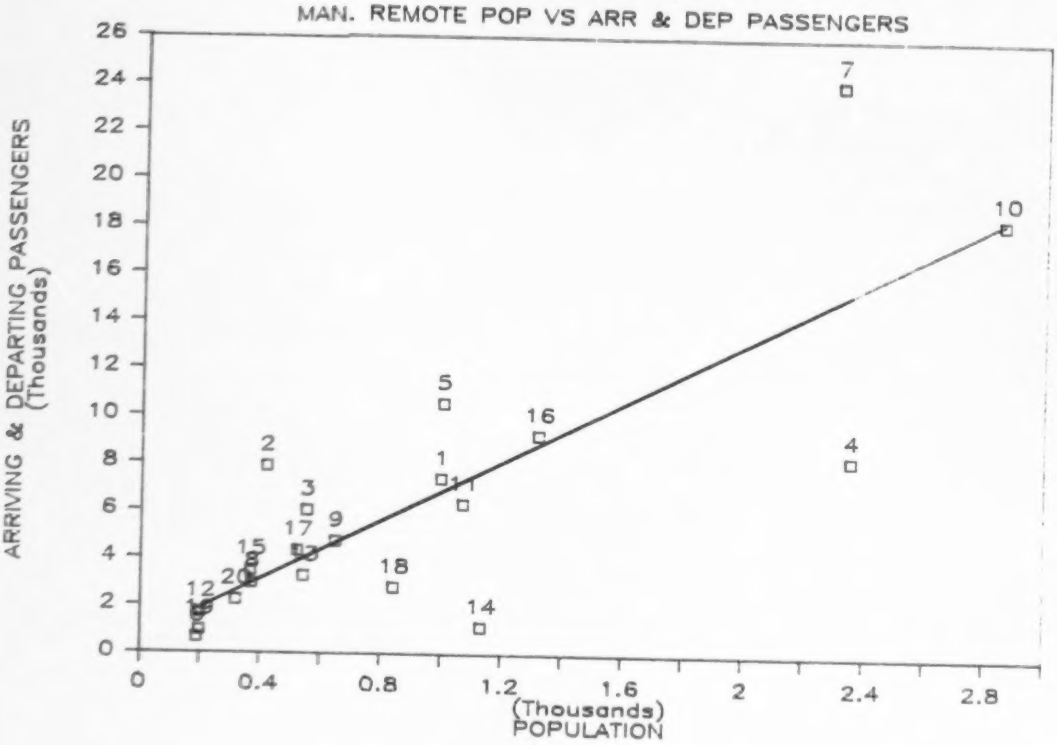


FIGURE 6.2

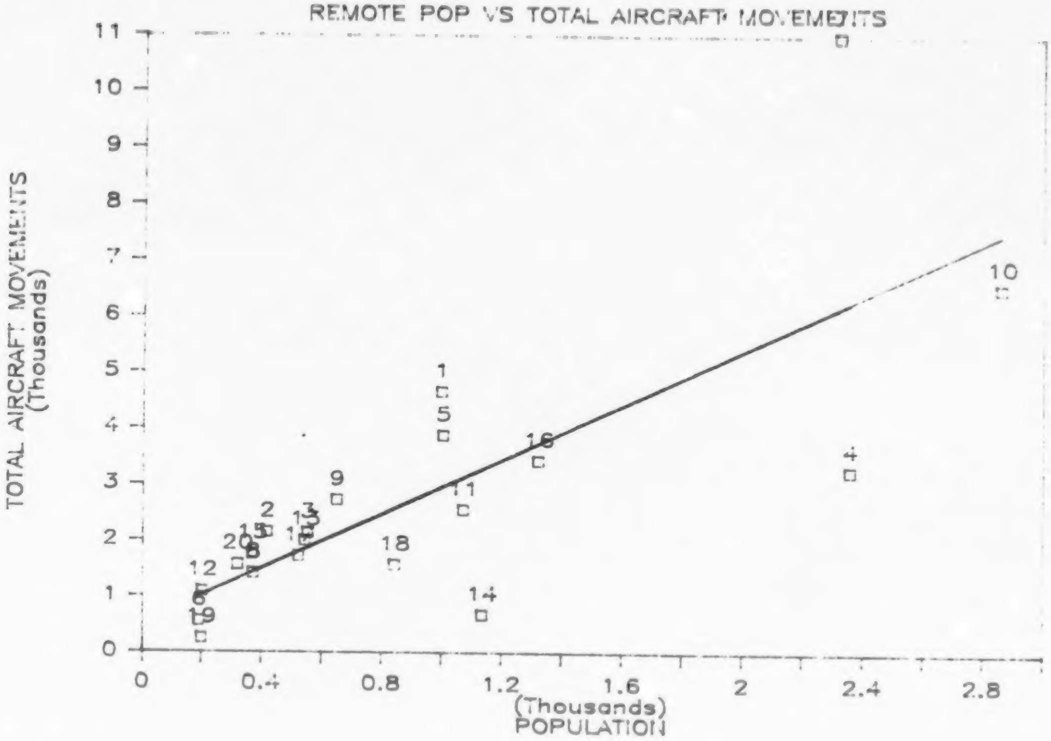
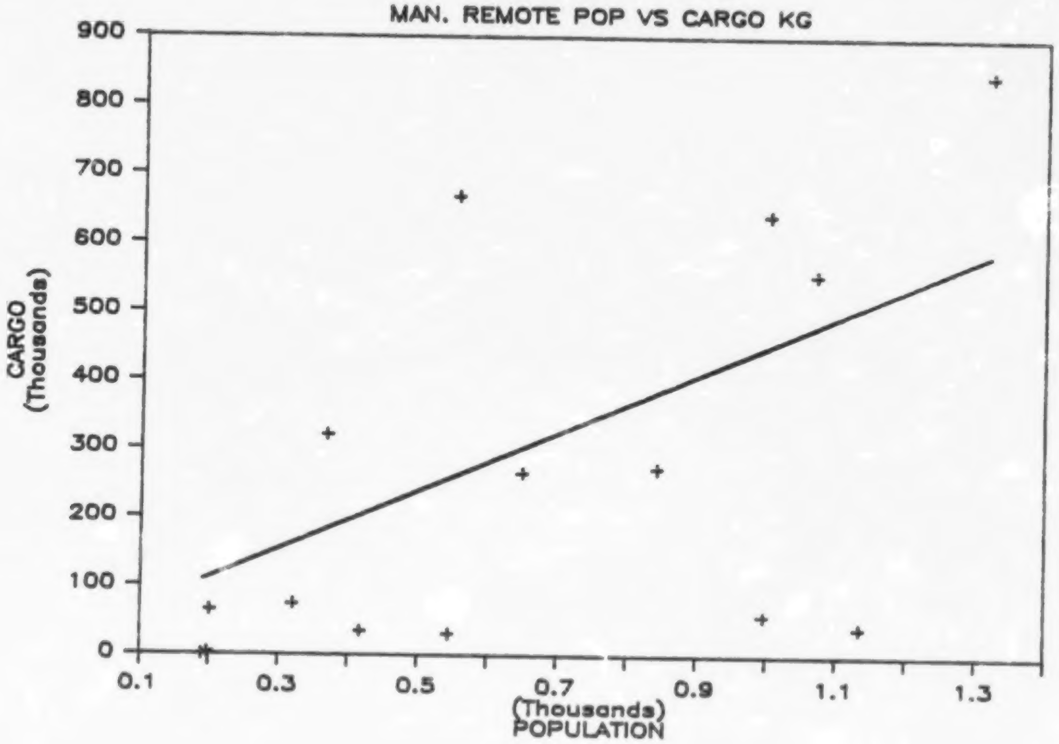

REMOTE POP VS TOTAL AIRCRAFT MOVEMENTS
TOTAL AIRCRAFT MOVEMENTS
(Thousands)
0
1
2
3
4
5
6
7
8
9
10
11
0
0.4
0.8
1.2
1.6
2
2.4
2.8
(Thousands)
POPULATION
1
2
3
4
5
6
8
9
10
11
12
13
14
15
16
17
18
19
20

FIGURE 6.3

MAN. REMOTE POP VS CARGO KG



Manitoba's formal air ambulance program with dedicated aircraft was scheduled to begin in April 1985. They provide a Northern Patient Transfer Program, which was established in 1977. This program subsidizes transportation cost for emergencies or the hospital transfers. "Of the 5,936 patient air warrants issued in 1982/83, 1586 were classified as urgent, or emergencies. A breakdown of the transport systems used indicates that the majority (72%) of patients were transported by scheduled airlines, 15% on special charter planes and 13% on the government Citation 1 jet."(8)

To estimate demand for emergency air services for remote communities, the focus should be on primary mission emergencies rather than routine patient transport including interfacility (inter-hospital) transport.

Manitoba conducted a study under Dr. Neil Donen, which estimated 700 emergency primary missions for remote communities north of the 53rd parallel.(8) Comparing this figure without emergency hospital services with the remote population of 32,000 for this area of Manitoba, yields an emergency air services demand of 0.021875 * population. The total population of the region is some 70,000 persons. This figure is very similar to the hospitalization rate estimated above (0.02304). Recent regional data for 1984/85 provided by Health and Welfare Canada revealed 510 emergency medical flights serving a population in Northern Manitoba of 23,000 for a factor of 0.022167.(9)

Northern Ontario data was collected for 1983 and 1984. Although air ambulance trip data was available, information on emergency vs. routine transfer was not available. Hence, Ontario ground ambulance data has been used here as a proxy. Land ambulance trips in Ontario for 1983 were comprised of 54 percent urgent and 46 percent patient transfers. Of the urgent trips, 48 percent were considered life threatening. Hence, it will be assumed in Table 6.2, "Air Ambulance Trip Data", that 26 percent (54 percent * 46 percent) of air ambulance trips were emergencies. The resulting air emergency evacuation demand (0.0333 to 0.1579) is higher than that estimated for Manitoba and that based on hospital morbidity rates. Since we lack accurate data for the Ontario air ambulance emergency demand, the subsequent benefit analysis will go with the more conservative estimate of 2 percent of the population per year.

6.3 Conclusions

Demand for air travel in remote areas has been estimated in this chapter on the basis of data obtained for Northern Manitoba. For the Manitoba area included in the study there is a remote population of 32,000 persons. This data revealed a significant level of air travel demand which is largely a reflection of the need to travel due to isolation and the lack of alternative year-round surface access. The level of income in a remote community does not appear to affect the demand for air travel. The estimation of demand for aeromedical transport has been based on three independent sources, i.e. Manitoba research forecasts of transports, hospital morbidity data and Ontario air ambulance trip data.

The air travel demand figures developed above are employed in estimating benefits to users of normal and emergency air services in Chapter 7.0.

TABLE 6.2
AIR AMBULANCE TRIP DATA
ONTARIO

AIR AMBULANCE BASE	NUMBER OF TOTAL TRIPS (1983)	NUMBER OF TOTAL TRIPS (1984)	ESTIMATED EMERGENCY TRIPS (1983)	ESTIMATED EMERGENCY TRIPS (1984)	SERVICE POPULATION *	PER CAPITA EMERGENCY TRIPS
SUDBURY	488	219	126.88	56.94	582	0.157921
THUNDER BAY	580	367	150.80	95.42	1897	0.064897
SIOUX LOOKOUT	647	759	168.22	197.34	5488	0.033305

* Service Population includes resident population where year round surface access is not available or the surface ambulance travel time to reach and transport a patient back to an emergency hospital exceeds 4 hours

Reference to Chapter 6.0

1. The norOntair Demonstration Project: Impact Evaluation Final Report, March 1975, Ontario Ministry of Transportation and Communications Program Analysis Office.

2. Airport Activity Summary Year End Summary 1983/84 from Manitoba DHT provided under covering letter to R. Slocum, RSWAL from Mr. Doug Chapman, Statistics Canada Aviation Statistics Centre February 18, 1985.

3. Northern Manitoba Population Statistics provided under covering letter to R.S. Wallace, RSWAL, from Mr. Jack Craven, Manitoba DHT Transportation Research, February 11, 1985.

4. Telephone Conversation between R. Slocum (RSWAL) and Pierre Sienema, Manitoba DHT Airports and Marine Division, March 5, 1985.

5. Hospital Morbidity, 1979-80/1980-81, Catalogue No. 82-206, July 1984, Statistics Canada.

6. Telephone Conversation between R. Slocum (RSWAL) and Pierre Govin, Indian and Northern Affairs Canada (INAC) November 9, 1984.

7. Medical Services Annual Review 1981, October 1983, Health and Welfare Canada (HWC) Medical Services Branch.

8. Aeromedical Transport - Province of Manitoba, Plus Attached References and Projected Transports, 1984 by K. Knaggs, B. Zumic and N. Donen, University of Manitoba Department of Anesthesia

9. Medivac Data (1978-1985), March 6, 1985, by Regional Director, HWC Manitoba Region, provided under covering letter to R. Slocum, RSWAL, from Dr. J.D. Copping, Health and Welfare Canada Medical Services Branch March 28, 1985.

7.0 SOCIO-ECONOMIC BENEFITS OF REMOTE AIRPORTS

The provision of airports to remote communities provides benefits at a number of different levels, i.e. the local community, government program delivery, air carriers and the contractors and industries involved in construction and material supply for the airport itself. This chapter discusses these benefits, quantifying them in economic terms where possible.

7.1 Local Community Benefits

7.1.1 Emergency Health Care

The emergency rescue of patients is a primary benefit of airport provision to an isolated community. Since a reasonable land ambulance alternative is not available, the benefits from an airstrip can be significant in terms of saving lives and reducing the extent of disability and loss of productive work time.

The key to the measurement of economic value is to determine the differences in circumstances and events and outcomes with an investment vs. without that investment. In this situation an estimate must be made as to the likelihood of a death or disability occurring had the emergency air service capability not been provided to the community.

A study on trauma reported in Scientific American produced some interesting historical data on military mortality and reduced lag times between injury and hospital treatment. The figures in Table 7.1, "Time Lag Between Injury/Surgery and the Mortality Rate" illustrate a marked reduction in mortality rates as access time to hospital facilities was reduced.(1) A 94 percent reduction in injury/surgery lag time resulted in an 80 percent reduction in mortality. This result was for military activity and is not necessarily representative of civilian experience. However, the above data can be used to draw a general conclusion, i.e. the reduction of time lag between the accident or incident and hospital treatment through the provision of aeromedical transport can result in significant savings to life.

	Time Lag	Mortality Rate
WWI	12 to 18 hours	8.5%
WWII	6 to 12 hours	5.8%
Korean Conflict	2 to 4 hours	2.4%
Vietnam War	65 minutes	1.7%

Table 7.1 Time Lag Between Injury/Surgery and Mortality Rate

Out of the estimated demand for emergency aeromedical transport for a given community, approximately 48 percent of the emergency rescue trips on average will be for patients with a life-threatening condition. This percentage is based on Ontario land ambulance data, as air ambulance patient condition data was not available for Manitoba or Ontario.(2) To estimate the probable number of remote community lives that might be saved through aeromedical transport, the Consultant has deferred to the judgement of medical experts. Dr. Neil Donen, Director of the Critical Care Unit at Winnipeg's St. Boniface Hospital and joint author of Aeromedical Transport - Province of Manitoba, made a rough estimate that 20 to 40 percent of critically injured patient's lives could be saved, if they are treated quickly enough through the use of an effective air ambulance service.(3) A limited medical helicopter study in Pennsylvania indicated that two lives out of the six critically injured case study victims were saved due to the more rapid transport of helicopter over land ambulance.(4)

A 1967/70 medicopter program at Ohio State University transported 50 patients (25 accident victims and 25 hospital transfers) of which 13 would have been dead on arrival if transported by surface mode, in the judgement of medical personnel.(5) This represents a life-saving percentage factor of 26 percent. However, since patient transfers are also involved, the effective percentage of "life-threatened patients" could be somewhat higher.

Hence, for analytical purposes, the Consultant has arbitrarily chosen a life-saving percentage factor of 33 percent of life-threatened patients, attributable to aeronautical transport.

For example, a typical community of 400 population will have a projected annual emergency aeromedical transport demand of 8 flights per year. Of these 8 emergency patients, 48 percent or 3.84 persons will be in a life-threatened condition and a further one-third of these or 1.28 persons will owe their lives to time savings of an air service.

The community will typically have limited air access most of the year (ski/float planes) and no access during the 6-8 week breakup/freezeup periods. Hence, an all-season airport would provide an incremental improvement in community access. With a significant improvement in quality of emergency service with dedicated specilly equipped and staffed wheeled aircraft, the Consultant has arbitrarily assigned an incremental improved health care impact due to the all-season airport equal to 50 percent for the 44-week ski/float plane season. During the freezeup/breakup periods (8 weeks), the emergency health care benefit is totally attributable to the new airport and aeromedical transport. Therefore, of the above 1.28 lives saved annually, 58 percent or .74 lives are attributable to the existence of the community airport.

The question that has no commonly accepted answer is: what economic value should be placed on lives prolonged through emergency aeromedical transport? A traditional method of valuation is to capture the summation of potential remaining life's earnings. These future earnings may or may not be discounted to a present value, depending on the perceived social discount rate. Building in a productivity increase in real earnings of say 3 percent per year for remote areas, the undiscounted summed value of average life earning (based on the age distribution of Indian mortalities) is $154,000. Discounting future earning power by a 10 percent rate yields $46,000. These figures also assumed that the saved victim was employed or potentially employable in the future. Housekeeping work is considered here to be employment worthy of valuation and for simplicity of analysis, is assumed to be equal to paid employment or self-employment.

Earnings and potential earnings in remote communities tend to be substantially lower than in urbanized areas. For example, the calculation of economic value of an urban dweller's life yields an undiscounted figure of $428,000 (assuming a real growth rate in wages of 2 percent) and at 10 percent discount = $114,000. The Canadian Aviation Safety Board (CASB) uses a valuation equal to approximately $390,000 (in 1983 dollars) per life lost, which is based on insurance industry claim settlement data.(6)

The above values tend to pale beside American figures which vary from US $650,000 (Federal Aviation Administration) to U.S. $3.5 million (Occupational Safety and Health Administration).(7)

Care is taken not to declare one true value for a human life, since there is no "market" to establish such a value. For analytical purposes however, the Consultant will assume a value for human life equal to the medium average of the low and high Canadian figures above, i.e. $237,000. Using this figure for the value of human life saved, the typical annual benefit to a remote community would be equal to ($237,000 * 0.74) or $175,380. This benefit would yield a present value over 20 years at 10 percent equal to $1,497,960.

Donald Trunkey reported in his Scientific American article on trauma that "... for each death there were at least two cases of permanent disability".(8) Hence, rapid air rescue to victims in remote areas should result in some degree of disability reduction. This benefit can be interpreted economically by estimating the average reduced work days lost due to temporary and permanent disabilities. If this reduction in lost productive time is estimated arbitrarily at 33 percent (to remain consistent with the above estimate of lives saved), the resulting dollar value of savings would be based on average productive earnings plus an implicit earnings value for housekeeping.

Taking the number of lives saved and attributable to the all-season airport as 0.74 per year and factoring this number by 2 yields an estimate of the number of potential permanent disabilities (precluded by an all-season airport capability) equal to 1.48. To measure the value of potential lost work days, the discounted value of remaining life earnings above ($46,000) is used. The annual value of precluded permanent disability is then estimated to be equal to (1.48 * $46,000) or $68,080 (Present Value over 20 years at 10 percent = $581,490).

To approximate the number of temporary disability days, the Consultant has drawn on an Ontario study of injured motor vehicle victims that found the average number of days lost from work was 15.7 and from housekeeping 14.4 days.(9) Using Indian mortality statistics for a proxy age distribution of disability,(10) 51 percent of the incident population would be subject to lost work or housekeeping. Without adjusting for unemployment, the lost earnings factor would equal the average remote annual wage or self-employed net income of $7,109 *0.51 or $3,625 per year ($13.94 per day). Taking the average work/housekeeping time loss at 15 days, the dollar value per average disabled victim becomes $209. The temporary disability reduction benefit per victim of rapid air evacuation for medical emergencies would be one-third of this figure or $69.72.

For the typical remote community of 400, this reduced temporary disability benefit can be estimated at 8 patients (the emergency, medical demand) * \$69.72 = \$558. Since just over half of these benefits represent the clear benefit of an all-season airport, a further adjustment by 58 percent yields \$324 per year. (Present Value over 20 years at 10 percent = \$2,754.)

There may be some marginal reduction in disability medical care costs. However, these may be offset by increased medical costs associated with victims who previous to air service availability would have died. Hence, the impact on medical costs are not included in this analysis.

7.1.2 Air Service User Time Savings

Air services provide a valuable benefit to normal, non-emergency travel to and from isolated communities, i.e. significant savings in access time. The lack of year-round access by surface transport or float/ski aircraft can impose substantial time penalties on travellers to and from these communities. The annual 6 to 8 week freeze-up/break-up periods in the North can often preclude travel of any kind. An all-season airport can thus save the air service user hours of travel over land or water and days or weeks of delay. An all-season airport also allows access by wheeled aircraft which offer a higher level of service over float/ski aircraft.

Economic valuation of these user benefits is related to the value of the time saving provided by the airport investment. The difficulty lies in establishing the average amount of time saved where an alternative mode (including float/ski plane) is not feasible due to freeze-up/break-up conditions.

Strictly speaking, the economic benefit would be one of increased air passenger travel output rather than user cost savings. The benefit value of such output is difficult to measure objectively due to the limited degree of market competition in the North and the problems in the measurement of consumer surplus in air fares. The Consultant has chosen to attribute the prorata time saving benefits of air services (accrued during the normal flying season) to the freeze-up/break-up period. Using this proxy surface mode comparison for one-way user time savings results in an average 5 hour savings over the bus mode for selected remote communities in Northern Manitoba (see Appendix D).

Placing a value on time savings to air users raises the following questions:

1. What is a representative value of a person's time, business vs. recreation or personal time, and

2. What amount of time savings is usable by the beneficiary?

In this study we are assuming that the value of business time savings is equal to the average earnings of a business traveller. The value of time to the personal traveller will be arbitrarily set equal to 1/3 of an average income level for the community and the amount of significant usable time savings will be deemed usable over ten minutes. Since visitors to these communities would be primarily business travellers, the dollar value of time saved would be greater for visitors than residents.

By estimating the travel demand by trip purpose for a representative community of 400 x the average time savings and unit values, the resulting economic value of time savings can be estimated.

The normal travel demand for a typical remote community of 400 population developed in Chapter 6 would equal 3,148 trips per year of which 2,518.4 would be for business/government purposes and 629.6 for personal reasons.

Employing the assumption that all of this travel would enjoy user time saving benefits, the total annual benefit would equal (2,512.0* $12/hour * 5 hours) + (628.0* $4/hour*.33 * 5 hours) = $155,260 per year.(11) Since remote communities often have some form of slower speed float/ski plane air service, the benefits that accrue from an all-season airport accrue due to the following factors:

- access during breakup/freezeup periods,
- improved passenger demand due to more reliable service,
- higher speeds of wheeled aircraft result in 10 percent higher time savings.

Based on these factors, the Consultant has assigned 32 percent of annual benefits, or $49,600 to the all season airport. (Present Value over 20 years at 10 percent = $422,050.)

7.1.3 Business/Employment Impact and Growth Potential

The provision of an airport with its access for passengers, goods and services allows the community to have a potential to expand economically. The realization of this potential, however, tends to be rather limited given the remoteness to these communities, the high transportation cost and adverse weather conditions for economic activities such as manufacturing. Clearly the greatest potential for economic activity lies in activities which serve the local community rather than export to the outside world. For example the local store will be able to be kept stocked currently, rather than depending on winter roads for seasonal access.

Airport-induced growth in local business and employment can be grouped into two categories:

1) airport operation and support activities, and
2) airport-users.

The construction of the airport itself would also have some short-term business/employment benefit. These are estimated under Section 7.4 below. Short-term construction employment and local spending benefits would not effect the long-term economic growth of the community.

The most direct local business and employment impact would be the operation and maintenance of the airport itself. The local airport may have an airport manager, a flight service officer, and one or two maintenance equipment operators. Alternatively, maintenance work may be contracted out, which would result in similar local employment. Since airports tend to hire locally, there may be no noticeable growth in population and local commercial business demand.

For security reasons, concession businesses are discouraged from locating at remote airports in Manitoba.(12) Such businesses require some airport management supervision to keep the airport neat and clean. Concession business also tends to attract vandals to the airport, which is difficult to police as it is usually some distance from the community.

Remote communities in the Provinces of Canada tend to be associated with Indian reserves rather than with rich mineral resource potentials. Hence, the business potential is related to the local community's requirements or must capitalize on a local natural resource, e.g. fishing, camping, for the tourism market.

The provision of an airport should improve the quality of business service by local businesses such as food retailers. However, it is unlikely to lead to growth in businesses or employment. There may be some growth in tourism business. However, tourists already have access most of the year through ski/float plane service.

7.1.4 Social Improvement

The access to the outside world via a community airport would provide positive, intangible benefits to the quality of social life. Greater communication (air mail) and visits with friends and relatives strengthens the social fabric of the community.

The quality of education can be enhanced with better access to teaching materials and higher teacher morale. The psychological benefits of reduced isolation (not feeling trapped) can raise the level of mental health in the community. Police protection and investigation is more efficient with air access; hence, the level of public safety is enhanced. Regionally-managed municipal services (sanitation, water and roads) are maintained/repaired more efficiently with air access, thus raising the quality of life and public health.

The receipt of food parcels by air mail can help to ameliorate the high cost of food in remote areas. Whether by air mail or air freight via a local store, the access to fresh produce year-round would raise the level of health and well being.

Many of these social benefits are discussed below under Government Program Delivery Benefits.

Not all of the impacts from improved access can be labelled as positive. For example, alcohol consumption can increase with a more reliable supply. A government official with Indian and Northern Affairs Canada observed that improved access has had some of the following impacts on the Inuit:

- Materially better off;
- More tooth decay;
- More disease; and
- Greater population growth.

He also cautioned that airports create a "dependency" that requires a long-term commitment to airport operation and maintenance.(13)

7.2 Government Program Delivery Benefits

The following discussion of more effective/efficient program delivery is based on Consultant interviews with staff of the Governments of Manitoba and Canada.

7.2.1 Health Care

Both the provincial and federal levels of government are concerned with the delivery of health care to remote communities. The provision of an airport allows for the expeditious transport of medical supplies and nurses for local nursing stations and routine medical patient transport (over 10,000 in 1984/85 in Northern Manitoba)(14) and, of course, permits the emergency air evacuation of trauma patients. The effective delivery of air emergency services is directly dependent on the provision of airports. Emergency aeromedical access is perhaps the largest single factor in the decision to provide airports to isolated communities.

The transport of fresh produce to isolated communities has had a positive preventive medicine impact on health.

7.2.2 Municipal Services

The Manitoba Department of Northern Affairs provides municipal-type services (sanitation, water and roads) to remote Manitoba communities.(15) Airports are important to program delivery by providing all-season accessibility. Although Manitoba trains local residents to handle minor municipal repairs, a major breakdown in a water or sanitation system would require Department staff and perhaps materials to travel to the site to effect repairs. Given the critical nature of water and sanitation to the level of public health, the provision of air access for emergency repair would be of great interest to the community and the government.

7.2.3 Education

Manitoba's Frontier Schools Program is dependent on community air access for the timely delivery of teachers, experts and materials.(16) Experts with various educational skills, e.g. music, learning disability training, counselling, etc. are often hired on a contract basis to serve a given school's specific needs for a short time period. An airport provides year-round access to this specialized educational assistance.

Teacher morale is maintained in part through the provision of one trip per year out of the community; again, air access assists the effective delivery of this program.

Where year-round air access is not available, e.g. Granville Lake, Manitoba, the Frontier Schools Program is faced with extra administrative costs for advance planning to ensure adequate school supplies are delivered prior to the break-up and freeze-up periods.

7.2.4 Police Services

Remote communities in Manitoba have local special constables with limited training and authority. The responsibility for carrying out criminal investigation lies with RCMP officers headquartered in sub-regional offices, e.g. Lynn Lake, Manitoba.(17) RCMP officers spend most of their working time visiting the communities within their sub-region. Air access is vital to the effective and efficient deployment of police resources over large geographic areas.

Communities without year-round air access, e.g. Tadoule Lake, Manitoba, are deprived of RCMP services during the break-up and freeze-up periods of the year.

7.3 Air Carrier Benefits

The opening up of a remote community to year-round access provides air carrier(s) with marginal increases in air passenger and freight business. The profit impact of this higher volume depends primarily on whether existing aircraft and staff can be utilized more efficiently. The location of the community would affect the ease of integrating the new airport into the air carrier's service network.

Air Carrier revenues can be estimated on the basis of expected air travel demand and average air fares in Northern Manitoba. For a typical community of approximately 400 population, the estimated travel demand is 3148 one-way trips per year. Using an average distance travelled of 225 km (based on average community distances to major destination points Thompson and Winnipeg). An average revenue of $0.21 per passenger-km is based on air fares provided by Perimeter Air and adjusted arbitrarily as follows: 10% Excursion Fares, 80% Adult Full Fare, 5% Child Fares, 5% Sr. Citizen Fares. This yields a total annual air carrier passenger revenue for this typical community equal to (3140* 225 * $.21) = $149,000.

In addition, the community will generate air freight demand. Based on reported data on air freight transport in Northern Manitoba, it can be estimated that approximately 197,490 kg of freight would move by air annually into a typical remote community (population 400). At a freight rate of $0.002 per kg per km and an average distance of 225 km, the air carrier would realize $89,000 in annual freight revenues.

Direct operating costs to the air carrier to serve a new or improved airport community comprise the following: fuel, maintenance labour and parts, pilots' salaries, depreciation and insurance. A range of direct operating costs as a function of changing load factors is presented in Table 7.2 "Average Airline Direct Operating Costs (DOC)".

Comparing the above revenue figures with the range in costs, the airline would recover its DOC and earn positive net operating revenues to apply toward fixed costs and profits. Expected air carrier revenues for a typical remote community of 400 population would equal $238,000 and the expected DOC (40% load factor) would equal $185,000. The achievement of this benefit is highly dependent on attaining reasonable load factors for the airline's aircraft.

The analysis here will assume that the typical remote community already enjoys some form of air carrier service (float and ski) during 10 months of the year. Hence, the above figures for higher expected revenues and costs should be adjusted to reflect the incremental amounts due to an all-season airport,

Destination	Load Factor	Average Annual DOC
Thompson	80%	$ 73,022
	60%	138,301
	40%	162,512
Winnipeg	80%	108,255
	60%	139,423
	40%	207,943
Average of Thompson and Winnipeg	80%	90,638
	60%	138,862
	40%	185,228

Source: Generated by RSWAL based on aircraft manuals, hypothetical air service networks for Northern Manitoba and 1985 cost factors.
See Appendix E

Table 7.2 Average Airline Direct Operating Costs (DOC) for a Typical Remote Community

i.e. approximately 23 percent higher revenues and 4 percent higher DOC. The incremental DOC is low due to the higher fuel costs of the ski/float aircraft for 10 months of the year. . The expected incremental revenue would equal $54,740 and the incremental direct operating cost would be $7,400, for an incremental net operating revenue figure of $47,340 per year. This analysis assumes that the ski/float plane service would be totally replaced by a wheeled aircraft service.

The aviation industry in general would benefit from enhanced safety through the provision of additional air strips for emergency landings in case of mechanical failure, severe weather conditions, etc.

7.4 Airport Construction/Supply Industry Benefits

The construction and equipping of an airport provides business income and employment directly to the construction firm and indirectly to manufacturing and service industries throughout the Canadian economy.

The Consultant requested Statistics Canada to conduct a special run of the Interprovincial Input-Output Model for one million dollars of airstrip construction in Manitoba.(18) The results are summarized in Table 7.3, "Person-Year Employment Impact of Airstrip Construction in Manitoba".

The direct employment above would also generate some degree of spending at the local store(s), thereby generating a limited income multiplier effect on the local economy. In Manitoba, local labour (skilled and unskilled) must be hired where it is available. In practice approximately half of the construction labour is local.(19)

	Southern Manitoba A/P Location
Direct Employment	10.1 P-Y
Indirect Employment	
- Manitoba	4.4 P-Y
- Canada	9.0 P-Y
Total	23.5 P-Y

Table 7.3 Person-Year Employment Impact of Airstrip Construction in Manitoba per $1,000,000

Since the above employment figures are on a per million dollar basis in Southern Manitoba; in those situations where the relative dollar cost per airport facility is higher, the jobs per dollar would be correspondingly lower. For example, if the remote construction costs were 2.5 times the southern costs, the total employment would be approximately the same, while the jobs per million dollars would be only 9.4 P-Y. This cost differential is due to higher transportation costs and the opportunity cost of having expensive construction equipment sitting idle for approximately one year between winter road seasons.

Profits would be approximately 10 percent to the construction industry and an additional 6 percent to the indirect (supply) industry.

The above analysis pertains to the airstrip construction only. Additional benefits would accrue to suppliers of the airport terminal building (ATB), navaids and maintenance equipment/vehicles.

7.5 Conclusions

The socio-economic benefits of year-round air access to remote communities are substantial both in quantitative and qualitative terms. The above analysis has quantified a number of these benefits. However, quality-of-life intangibles such as the level of police protection have been dealt with in descriptive terms only.

By focusing on a typical remote community of 400 population, the study has developed a representative level of benefits that would be anticipated from the construction and operation of an all-season airport. The quantifiable benefits are illustrated in Table 7.4 "Remote All-Season Airport Benefits". These benefits are compared with airport/aircraft costs in a benefit/cost framework in Chapter 9.0.

Non-quantifiable benefits should also be considered in the evaluation of the merits of remote airports. As described above, the benefits include enhanced quality of community life; more effective government program delivery to the community; enhanced economic growth potential for the community; and nominal local permanent employment at the airport. Government programs can be much more effective and efficient with improved air access; e.g. routine health care, municipal services maintenance, educational materials/resources and police investigation/protection.

	Annual Benefit	Present Value Benefit (20 years @10%
Emergency Health Care:		
Lives Saved	$ 175,380	$1,497,960
Disabilities Prevented	68,080	581,490
Temporary Work Days Saved	320	2,750
Air Service User Time Saving	49,600	422,050
Total	$ 293,380	$2,504,250

Table 7.4 Remote All-Season Airport Benefits

In addition to community benefits, the air carrier industry benefits from increased traffic and the airport construction/supply industry benefits from increased business activity.

References to Chapter 7.0

1. "Trauma", *Scientific American*, Volume 249, No. 2, pp 33, 34, August 1983, by Donald D. Trunkey.

2. Telephone Conversation between Tom Habicht, RSWAL and Malcolm Bates, Ontario Ministry of Health Land Ambulance Section, February 26, 1985. 1983 Data:
   Total Patient Calls = 616,000
   Urgent Calls = 333,000
   Life Threatening = 159,082

3. Interview with Dr. Neil Donen, Director of Critical Care, St. Boniface Hospital, Winnipeg, Manitoba by Dr. R.S. Wallace, RSWAL, at St. Boniface Hospital on March 21, 1985.

4. Helicopter Ambulance Study, May 1969, by Robert R. Coleman, Pennsylvania Department of Highways.

5. "Helicopter Ambulance: An Evaluation of Their Operational and Economic Feasibility". Traffic Digest & Review, Vol. 19, No. 7, pp 1-7, July 1971, by Hale C. Bartlett.

6. Based on a Computer Printout Received from Michael W. Tyler, Canadian Aviation Safety Board (CASB), Safety Studies, March 8, 1985.

7. "What Is the Audited Value of Life?" New York Times, October 26, 1984, p. A-24, by Bill Keller.

8. Donald D. Trunkey, *op. cit.*, p. 28.

9. INJURY an Ontario Survey of the Societal and Personal Costs of Hospitalized Motor Vehicle Accident Victims, July 1981, Ontario Ministries of Health and Transportation and Communications.

10. Medical Services Annual Review, 1981, October 1983, Health and Welfare Canada Medical Services Branch.

11. Employment, Earnings and Hours, Catalogue No. 72-002, p. 138, for Winnipeg for commerce, business and personal service industry salaries and inflated by 5 percent to yield 1985 values, June 1984, Statistics Canada; and Isolated Communities Digest of Transportation Social and Economic Data, No. 10-77-5, June 1977, Canadian Transport Commission Research Branch. A lower base wage rate of $4/hour is used for personal travel to reflect the lower income levels in remote communities.

12. Telephone Conversation between R. Slocum, RSWAL and Beth Mindielle, Manitoba DHT Airports and Marine Division, February 18, 1985.

13. Telephone Conversation between R. Slocum, RSWAL and Alec Jenkins, Indian and Northern Affairs Canada (INAC) Social Development Directorate, January 16, 1985.

14. Medivac Data (1978-1985), March 6, 1985, by Regional Director, HWC, Manitoba Region, under covering letter to R. Slocum, RSWAL, from Dr. J.D. Copping, Health and Welfare Canada Medical Services Branch March 28, 1985.

15. Telephone Conversation between R. Slocum, RSWAL and Peter Hunchak, Northern Affairs Manitoba April 2, 1985.

16. Telephone Conversation between R. Slocum, RSWAL and Tina Pysh, Manitoba Frontier Schools, Thompson April, 1985.

17. Telephone Conversation between R. Slocum, RSWAL and RCMP Office of Lynn Lake Manitoba April 1, 1985.

18. Economic Impact $1,000,000 in Spending on Commodity 524 (Road Highway Airstrip Construction) Target: Manitoba, March 29, 1985, provided by Michel Bedard, Statistics Canada Input-Output Division.

19. Telephone Conversation between R. Slocum, RSWAL and David Selby, Manitoba DHT Airports and Marine Division April 11, 1985.

8.0 EXPECTED AIRCRAFT ACCIDENTS

8.1 Introduction

The provision of an airport and air services also contains the risk of an aircraft accident. Two categories of risk are important to distinguish for this study:

(a) aircraft accidents that occur due to the nature of flying (pilot's skill, equipment, weather conditions, communications, etc.) and

(b) aircraft accidents that may occur due to the airport design, construction, operation and maintenance guidelines developed in this study and subsequently implemented.

Table 8.1, "Expected Annual Aircraft Accidents and Costs for a Typical Remote Community" addresses the first category above. The indicated annual total cost of $33,920 ($36,290 in 1985 dollars) for a typical remote community covers aircraft accidents both at the airport and enroute. On average, approximately 70 percent of aviation accidents, excluding scheduled operations, occur at the airport.(1) An analysis of Canadian private avaition revealed that the airport itself was a causal factor in 2.6 percent of total accidents and 1.5 percent of casualty accidents.(1)

The sections below detail some of the difficulties encountered in approaching the second risk category (b) above. Risk related to airport design, construction, operation and maintenance is an area where further research is required.

8.2 Canadian Aircraft Accident Data

The Canadian Aviation Safety Board (CASB) maintains an extensive computer based data bank on all reported aircraft accidents in Canada. This data base includes detailed accident information concerning aircraft, pilot, weather and airport characteristics.

The Consultant requested the CASB to examine their data base for the Study Zone (remote areas of the provinces) to determine the airport accident frequency for different length runways, runway surface types and status for fixed-wing airplanes of 5,669.9 kg (12,500 lbs) and under maximum takeoff weight. See Appendix F for the specified parameters of the data search. The results of their computer search were surprising. Only one reported air accident at an airport was found between 1976 and 1984 for runway lengths equal to or less than 914.4 m (3,000 ft). There are roughly 500 airports with runway lengths less than 914.4 m (3,000 ft) in the Study Zone. Clearly, one accident datum is not sufficient to form judgements concerning the effect of airport design parameters on accident frequency in remote areas.

To ensure that their result was of the correct order of magnitude, CASB searched their data base for longer runways and for all of Canada. See Table 8.2 "Canadian Fixed-Wing Aircraft Accidents 1976 to 1984"

Annual Flying Hours**	Accident Rate Per 100,000 hrs*	Average No. of Expected Accidents per Year	Cost per Accident***	Expected Annual Accident Cost (1983)
1228.0	14.9 (Commercial)**** and Government	.1830	$161,134	$ 29,490
92.4	27.5 (Private)	.0254	161,134	4,090
14.0	14.9 (Medivac)	.0021	161,134	340
Total		0.2105		$ 33,920

* For aircraft ≦ 5,669.9 kg (12,500 lbs). By special request to the CASB.(2)

** Aircraft movements were derived from regression analysis of Northern Manitoba data submitted to ASC(3). Flying hours based on projected air travel times for selected candidate remote communities in Northern Manitoba, Average Time = 0.875 hour to or from Thompson or Winnipeg. Commercial/private flying split 93%/7% based on N. Manitoba movement data(3) 1509.1 aircraft movements * 0.875 * .93 = 1228.0; 1509.1 * 0.875 * .07 = 92.4.

*** For commercial and private aircraft ≦ 5,669.9 kg (12,500 lbs). By special request to the CASB, computer printout March 6, 1985, Job No. 1896.(2) Cost in 1983 dollars include injuries, fatalities, hull damage, search and rescue, investigations, insurance administration and loss of aircraft use.

**** This is an estimated figure for the T/O Weight group ≦ 5,669.9 kg (12,500 lbs) and may be 8 to 10% too high or too low, per M. Tyler, CASB.(2)

Table 8.1 Expected Annual Aircraft Accidents (Enroute and On-Airport) and Costs for a Typical Remote Community (Pop. 400)

	Number of Reported Accidents
All Aircraft Accidents in Canada	5,884
Aircraft ≦ 5,669.9 kg (12,500 lbs) at an airport in Canada	98
Aircraft ≦ 5,669.9 kg (12,500 lbs) at an airport with runway ≦ 914.4 m (3,000 ft) in Canada	51
Aircraft ≦ 5,669.9 kg (12,500 lbs.) at an airport in Study Zone	7
Aircraft ≦ 5,669.9 kg (12,500 lbs) at an airport with runway ≦ 914.4 m (3,000 ft) in Study Zone	1

Table 8.2 Canadian Fixed-Wing Aircraft Accidents(4) 1976 to 1984

While the paucity of accident data precluded a quantitative risk analysis of airport design parameters, the low accident frequency highlighted the low risk of airport accidents for aircraft 5,669.9 kg (12,500 lbs) in Canada. This is the size of aircraft most likely to utilize the remote airports under study.

Further study of the effect of airport design parameters on safety is recommended.

8.3 American Aircraft Accident Data

The National Transportation Safety Board (NTSB) maintains a computer based data bank similar to that of the CASB in Canada. When asked to provide a similar accident data search, the NTSB readily agreed. Unfortunately, their output is for all fixed-wing aircraft (not just 5,669.9 kg (12,500 lbs) as in the CASB run) and no accident exposure (number of movements or flying hours) information was available.

Notwithstanding these drawbacks, the NTSB on-airport accident data breakdown by runway length, surface composition and condition does provide some insight into accident frequencies.

For the single-engine, fixed-wing aircraft (which would tend to be under 5,669.9 kg (12,500 lbs) T/O weight), there were 653 (4.2 percent of accidents between 1972 and 1981), on runways under 457 m (1500 ft) in length and 6751 (43.6 percent of accidents) for runways ≤ 914 m (3000 ft).(5) (Canada's accident experience for fixed-wing aircraft ≤5,669.9 kg (12,500 lbs) max. T/O weight for runways 914 m (3000 ft) between 1976 and 1984 was 51 accidents or 52 percent.) See Table 8.3 "Summary of U.S. On-Airport Accidents".

Runway	(1972-1981) Number/% of Total Multiple Engine	Single Engine
Water	9/.3%	135/.9%
<457 m (1500 ft)	8/.3%	653/4.2%
457 m - 914 m (1500 ft - 3000 ft)	442/16.6%	6098/39.4%
914 m - 1,219 m (3000 ft - 4000 ft)	415/15.6%	3042/19.7%
1219 m - 1524 m (4000 ft - 5000 ft)	399/15.0%	1778/11.5%
<1,524 m (5000 ft)	1133/42.6%	2500/16.2%
Unknown	256/9.6%	1266/8.2%
Total	2662/100%	15472/100%

Table 8.3 Summary of U.S. On-Airport Accidents(5)
Fixed-Wing Aircraft

The aircraft statistics as a function of runway surface composition revealed a higher percentage of total accidents on grass/sod runways for single engine aircraft (21.4 percent) than for multiple engine aircraft (5.5 percent). This statistic may not be prejudicial to grass strips, as one would expect a higher frequency of grass strip use by single-engine aircraft. At 3.3 percent, for single engine aircraft, the gravel strip accident frequency is substantially lower than grass strips.

The U.S. accident data for runway surface condition revealed a slightly higher accident percentage for single-engine fixed-wing aircraft vs. multiple engine fixed-wing aircraft for "rough/uneven" conditions (2.0% vs. 0.9%). The reason may be associated with the greater use of grass strips by single-engine aircraft discussed above.

8.4 Modal Comparisons of Accident Risk

Accident data is reported for all the major transport modes, i.e. air, highway and rail. The rates reported are on the basis of vehicle miles or hours travelled. Hence, comparison between modes should reduce these accident rates to some common denominator. The measure common to air is accidents per 100,000 hours flown, while motor vehicle accidents are measured against 100 million vehicle miles driven.

Comparisons can best be viewed in tabular form in Table 8.4, "Canadian Accident Rates by Modes". In this table "Fatal Accident Rate" refers to the frequency of accidents with one or more fatalities; the "Fatality Rate" refers to the frequency of fatalities.

The above table illustrates the low risk per 100,000 hours of commerical aviation accidents compared with travel by road. The risk to aeromedical transport would be similar to that experienced by commercial air carriers. However, it can be observed that the risk of an accident per 100,000 hours in private aviation is somewhat higher than other modes. It is also clear that the risk of a fatality is higher in aviation, due to the generally greater severity of the accident impact.

What is clear is that applicable aviation both commercial and private has been exceptionally accident free in the Study Zone. This fact, coupled with the relatively higher safety of commercial (and aeromedical) aviation compared with other modes, indicates that airport design parameters are changeable in the direction of lower cost and higher risk. Where the risk of an accident at an airport is quite low, that risk may be raised and still remain low relative to other modes. Referring back to Table 8.4, the national risk figures for scheduled and non-scheduled air carrier operations are low at 0.76 and 5.57 accidents per 100,000 hours (70% of the non-scheduled aviation accidents occur at an airport) compared with a calculated figure for road of approximately 22.15 per 100,000 hours. Based on a measure of fatalities per passenger-km travelled, scheduled air operations produce 8% as many fatalities as road. A "non-fatality" index, with road fatalities per passenger-km set at 1.0, indicates that scheduled air travel is 12.5 times as safe as road. Risk associated with commercial aviation could be doubled or tripled and still remain lower than travel by road.

Mode:Operation	Vehicle Accident Rate/ 100,000 vehicle-hrs	Fatal Vehicle Accident Rate/ 100,000 vehicle-hrs	Fatality Rate 100,000 vehicle-hrs	Fatality Rate/ passenger-km x 10^6	Non-Fatality Index	Person-Accidents/ passenger-km x 10^6
Air: (1979)						
All Operations	17.74	2.64	6.04	n.a.	n.a.	n.a.
Scheduled Operations	.76	.19	3.22	.00088****	12.5	0.011
Unit Toll Non-Scheduled Operations	5.57	1.67	7.24	n.a.	n.a.	n.a.
Private Operations	32.55	4.13	8.52	n.a.	n.a.	n.a.
Commercial Fixed-Wing Aircraft 5,669.9 kg (12,500 lbs) max. T/O weight*	18.1 11.4 (1982)	2.9 1.7 (1982)	n.a.	n.a.	n.a.	n.a.
Private Fixed-Wing Aircraft 5,669.9 kg (12,500 lbs) max. T/O wt.	26.7 24.8 (1982)	4.0 2.5 (1982)	n.a.	n.a.	n.a.	n.a.
RAIL: (1983)						
All Operations Excluding RR/Hwy Crossing Accidents	.24		.04**	.0000088*****	1,250	0.060
ROAD: (1979)						
All Operations	22.15		.17***	0.011******	1.0	3.692

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* Due to estimating error, figures could be ± 10%.
** Conversion assumes 40 km/hr.
*** Conversion assumes 60 km/hr.
**** Based on average 55 passengers/flight; 680 km/hr.
***** Based on average 117 passengers per passenger train.
****** Based on average vehicle occupancy of 2.5.

Sources: Air Accident Data from the Dubbin Commission Report(6) and for Fixed-wing Aircraft 5,669.9 kg (12,500 lbs) from CASB(2)
Rail accident data from the CTC(7) and Statistics Canada(8)
Road accident data from Transport Canada(9)

Table 8.4 Canadian Accident Rates by Mode

It is not the Consultant's intent to consciously increase risk by such large factors. However, the above discussion helps to put the level of aviation safety in perspective.

8.5 Sensitivity Analysis

Given the lack of appropriate airport accident data, the Consultant suggests a sensitivity analysis of possible increased risk that could be associated with the design guidelines suggested in this report.

Of the 0.2105 annual aircraft accidents and $36,290 in annual total accident cost, approximately 70 percent or 0.1474 accidents and $25,403 is likely to occur at an airport. Since there are at least two airports involved in a trip, the number of accidents and cost can be split in half, i.e. 0.0737 accidents and $12,702 in accident costs possibly occurring at the study airport annually. Of these on-airport accidents, only a few would be due to the airport itself. Since we are testing changes in airport standards, the 0.0737 and $12,702 figures will be used as base line numbers. In other words, how would a change in the airport itself affect the number and cost of accidents?

Sensitivity testing allows the analyst to observe the effect of a range of changes in risk, where the exact effect cannot be predicted. For example, should the airport design changes double the risk of an accident, the number of on-airport accidents might double to 0.1474 per year and the total accident cost would be ($12,702*2) = $25,403 per year. Hence, the incremental number of accidents would be 0.0737 per year and the increment of cost would equal $12,702. This sensitivity approach will be applied in the evaluation of alternative combinations in Chapter 9.

The above analysis is appropriate to an annual increment of change. However, the all-season airport discussed here provides a benefit (and risk) primarily for the eight-week isolation period with service and safety advantages over float- or ski-plane for the remainder of the year. Hence, when the above annual figure for on-airport accident cost is factored for the incremental impact it becomes ($12,702 * 8/52) or $1954. (Present Value of 20 years at 10% = $16,640.)

Appendix G "Airport/Aircraft Combinations Summary of Costs and Benefits", contains detailed tables which test the sensitivity of accident costs to various levels of risk. The evaluation includes the aviation risk for in-flight accidents as well, since the approach considers the incremental changes with vs. without the all-season airport.

8.6 Conclusions

The provision of an all-season airport to a remote community is a mixed blessing, since air travel involves the risk of an air accident. The various airport design/aircraft combinations reviewed in this report may introduce an additional unknown element of risk.

Adequate data on aircraft accidents as a function of airport design is not available. Hence, the approach taken here is to test the socio-economic cost impact of higher levels of risk. Table 8.5, "Aircraft Accident Risk Associated with Airport Design for Typical Remote Community Population = 400 - Sensitivity Test", summarizes the sensitivity testing of increasing on-airport accidents.

Incremental Risk Factor due to Airport Design	Incremental Accident Cost Impact	Present Value of Incremental Costs Over 20 Years @ 10%
1.5	$ 977	$ 8,320
2	1,954	16,640
3	3,908	33,270

Table 8.5 Aircraft Accident Risk Associated with Airport Design for Typical Remote Community Population = 400 - Sensitivity Test

There is evidence to suggest that the cost figures in Table 8.5 are overstated. Canadian accident data revealed a very low number of accidents on airports in the Study Zone (remote areas of the provinces), i.e. only 7 accidents from 1976 to 1984 for fixed-wing aircraft with maximum takeoff weight equal to or less than 5,669.9 kg (12,500 lbs). The costs in Table 8.5 are based on Canada average on-airport accident rates for all aircraft.

Commercial aviation (including aeromedical transport) is particularly safe when compared with other transport modes. This leads to the premise that airport safety could be reduced without sacrificing air's relative risk position vis-à-vis the other modes.

Although inconclusive, accident data obtained from the States suggested higher risks occur from operations on grass/sod runways and rough/uneven runway surface conditions.

Further research is needed to establish the risk of changing airport design parameters. The Air Navigation Technology Development Division of Transport Canada is commencing the development of a risk model to assess, among other questions, deviations from current airport design standards. Once developed, this model will be capable of assessing the risk of obstacles and short or narrow runways.(10)

References to Chapter 8.0

1. Report of the Commission of Inquiry on Aviation Safety, Volume 1, May 1981 by The Honourable Mr. Justice Charles L. Dubin, Commissioner, Inquiry on Aviation Safety.

2. Telephone Conversation between R. Slocum, RSWAL, and Michael Tyler, Canadian Aviation Safety Board (CASB) Safety Studies, March 7, 1985.

3. Aircraft Movement Statistics Annual Report 1983, TP 577, April 1984, Statistics Canada, Aviation Statistics Centre (ASC).

4. Telephone Conversation between R. Slocum, RSWAL, and Sylvie Girard, CASB April 19, 1985.

5. NTSB Computer Printout for Fixed Wing Aircraft Accidents 1972-1981 provided under route memo from Stan Smith, National Transportation Safety Board (NTSB), Washington, D.C. June 11, 1985.

6. Dubin, op. cit. Vol. 1, Tables 12 to 14 and 24.

7. 1983 Summary of Railway Accidents/Incidents as Reported to the Canadian Transport Commission, 1984, Canadian Transport Commission (CTC) Railway Transport Committee (RTC) Operations Branch.

8. Railway Operating Statistics, Catalogue No. 52-003, December 1983, Statistics Canada.

9. Telephone Conversation between R. Slocum, RSWAL, and Sandy Ste. Marie, Transport Canada Motor Vehicle Accident Statistics Section May 21, 1985.

10. Telephone Conversation between R. Slocum, RSWAL, and Neal Standon, Transport Canada Air Navigation Technology Development Division July 5, 1985.

9.0 SELECTION OF A RECOMMENDED AIRPORT/ AIRCRAFT COMBINATION

9.1 Introduction

This study has developed the technical engineering and socio-economic characteristics for several alternative combinations of aircraft type and airport design. The analytical data has been developed for a typical remote community with a population of 400 located in Northern Manitoba.

This chapter brings this data together in an evaluation framework of benefits and costs, including safety. Assessment criteria are described and discussed followed by the assessment of alternative aircraft/airport combinations. A Transport Canada typical airport design is also costed as a reference case for comparison purposes.

The Phase 2 Report ends with the selection and recommendation of an airport design for an appropriate aircraft type(s).

9.2 Assessment Criteria

The alternative combinations of aircraft type and airport design have been assessed for their impact on cost, safety, and benefits. Technical criteria are not included as each alternative has already been screened for engineering feasibility. Feasibility of implementation is also discussed below. However, assessment under this criteria is deferred to Phase 3.

9.2.1 Cost

Costs reflect the utilization of economic resources (land, labour, capital and management). Lower cost for remote airports is an important objective of this project. Costs considered here include all of the civil works at or related to the airport construction; the buildings and equipment (maintenance, navaids) required at the airport; the annual O&M costs for the airport and related services (e.g. an access road); the direct aircraft operating costs of bringing in emergency and normal air services; and accident costs. These costs are estimated over a 20-year analysis period with all future costs discounted at 10 percent to their present values. This allows a common dollar value base for cost comparisons between alternatives and comparison of costs with benefits.

9.2.2 Safety

The provision of an all season airport to any community introduces an increased level of potential aircraft accidents, simply due to the greater number of aircraft movements into and out of the community. For this study, the important safety question is: does the particular combination of aircraft type and airport design adversely affect the level of on-airport aircraft accident risk?

A definitive answer to this question requires further research into airport causation of aircraft accidents. Notwithstanding the lack of statistical evidence to establish airport design impacts on risk, the Consultant has developed a range of increased risk and accident costs through sensitivity analysis.

Due to the adequate bearing strength of runway shoulders, undershoot and overshoot areas, the probability of accidents may not in fact increase with shorter and/or narrower runways. The cost of an increase in risk is tested in any event.

9.2.3 Benefits

The benefits of improved air access for remote communities are divided into quantifiable and intangible benefits. In addition, benefits are described for the air carrier, the airport construction business and related supply industry, and government program delivery.

Quantified community benefits include: emergency health care (lives saved, disabilities reduced); air service user time savings, and long-term and short-term employment generation.

Intangible community benefits include improved quality of life, more effective social services, stronger ties to family and friends, etc.

9.2.4 Feasibility of Implementation

Impediments to implementation fall into three categories: legal/procedural; financial; and jurisdictional. The Federal Government has specified legal powers in the area of aviation that could affect the implementation of new airport designs for remote areas. Financial issues involve questions of budget priorities and various grants and subsidies available for airport construction/O&M. Jurisdictional issues can involve different levels of government as well as different departmental authorities within a government.

These possible impediments to implementation are to be identified and evaluated in Phase 3.

9.3 Assessment of Alternative Airport/Aircraft Combinations

Airport/aircraft combination and the TC standard design for airports can be viewed in the light of benefit, cost and safety criteria in Table 9.1, "Airport/Aircraft Combinations Summary of Incremental Benefits and Incremental Costs". As a simplifying assumption, this table evaluates the combinations for Manitoba operating conditions of 22°C temperature and runway elevation of 305 m (1000 ft) above sea level and gravel pavement type. Appendix G contains detailed spreadsheets of a range of operating conditions and pavement types. The effect of pavement type on costs is shown for a sample airport/aircraft combination in Table 9.2, "Pavement Costs for Sample Airport/Aircraft Combination". The selection of pavement type is usually a function of available materials rather than a discretionary decision.

Pavement Type: Gravel
Manitoba Operating Conditions:
- 1000 ft elevation
- 22°C temperature
Typical Remote Community Population: 400

Aircraft	Operating Weight (kg)	Operating Weight (lbs)	Runway Pavement Length (m)	Runway Pavement Length (ft)	Present Value Total Benefits	Present Value Total Costs	Net Present Value	Normal Risk B/C Ratio	High Risk* B/C Ratio	Employment Impact Long-Term (Annual P-Y)	Employment Impact Short-Term (P-Y)
C-185	1360.8	3,000	404	1,325	$ 2,504,000	$ 1,240,000	$ 1,264,000	2.02	1.97	1.8	12.2
C-185	1519.5	3,350	525	1,722	2,504,000	1,302,000	1,202,000	1.92	1.88	1.8	13.5
DHC-6 (STOL)	4535.9	10,000	263	863	2,504,000	1,158,000	1,346,000	2.16	2.11	1.8	10.8
DHC-6 (STOL)	5669.9	12,500	403	1,322	2,504,000	1,229,000	1,275,000	2.04	1.99	1.8	12.2
DHC-6 (CAR-3)	4535.9	10,000	303	994	2,504,000	1,178,000	1,326,000	2.13	2.07	1.8	11.2
DHC-6 (CAR-3)	5669.9	12,500	494	1,621	2,504,000	1,276,000	1,228,000	1.96	1.92	1.8	13.2
Citation II	4989.5	11,000	785	2,575	2,504,000	1,548,000	956,000	1.62	1.59	1.8	16.4
TC Typical Design		All of the Above Aircraft Types & Weights	930	3,051	2,504,000	1,715,000	789,000	1.46	n/a	1.8	21.8

* Risk taken as 3.0 times normal.

Table 9.1 Airport/Aircraft Combinations Summary of Incremental Benefits and Incremental Costs

TABLE 9.2
PAVEMENT COSTS FOR SAMPLE AIRPORT/AIRCRAFT COMBINATION

A/C: DHC-6
Temp: 15 C
Elev: 0 m.
GTOW: 5670 kg (12500 lbs)
STOL

				PAVEMENT TYPE (P)			
	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$19,250.00	$16,500.00	$30,250.00	$35,750.00	$143,000.00	$390,500.00	$63,250.00
2. Car Park (5 cars)	$350.00	$300.00	$550.00	$650.00	$2,600.00	$7,100.00	$1,150.00
3. Aircraft Apron (2 Twin Otter A/C)	$4,987.50	$4,275.00	$7,837.50	$9,262.50	$37,050.00	$101,175.00	$16,387.50
4. Taxiway (taxiway width = 7.5 m.)	$1,050.00	$900.00	$1,650.00	$1,950.00	$7,800.00	$21,300.00	$3,450.00
(taxiway length = 40 m.)							
5. Runway (non-instrument)	$247,859.64	$243,941.51	$252,443.41	$256,375.67	$337,504.09	$510,006.44	$276,036.97
Subtotals	$273,497.14	$265,916.51	$292,730.91	$303,988.17	$527,954.09	$1,030,081.44	$360,274.47
(strip length = 426 m.)							
(graded area width = 38 m.)							
(runway pavement width = 15.2 m. max to 7.6 m. min)							
(runway pavement length = 366 m.);gravel=	373 ;	turf=	380				
Paving Subtotals:1+2 :	$19,600.00	$16,800.00	$30,800.00	$36,400.00	$145,600.00	$397,500.00	$64,400.00
3+4+5 :	$253,897.14	$249,116.51	$261,930.91	$267,588.17	$382,354.09	$632,481.44	$295,874.47
Paving Totals:	$273,497.14	$265,916.51	$292,730.91	$303,988.17	$527,954.09	$1,030,081.44	$360,274.47

Source: R.S. Wallace & Associates Ltd.

9.3.1 Incremental Benefits vs. Incremental Costs

Table 9.1 contains "incremental" benefit and cost figures, i.e. the increase or decrease in the benefits and costs resulting from the construction, operation and maintenance of an all-season airport in a typical remote community of 400 population.

Incremental benefits include the improvement (lives saved, disability reduced) in emergency health services; normal air service user time savings and long-term/short-term employment impacts. Incremental costs include the costs of airport construction and O&M; direct operating cost of emergency aeromedical transport and normal air service (at 60 percent load factor) aircraft; and normal and possible increased risk of aircraft accidents.

For all of the combinations and the TC typical design, the Net Present Values are positive ($576,000 to $1,346,000) and Normal Risk B/C Ratios are greater than one (1.30 to 2.16).

Employment impacts were 1.8 person-years per year in permanent employment at the airport and 10.8 to 21.8 person-years of short-term employment: the more costly the airport construction, the higher the short-term employment impact. The High Risk B/C Ratio reflects the sensitivity impact of a hypothetical tripling of on-airport accident risk. These ratios (1.59 to 2.11) illustrate only a nominal decrease in economic efficiency associated with possibly higher-risk airport design standards.

9.3.2 Intangible Factors

In addition to a consideration of quantifiable benefits and costs, the community will experience intangible impacts on its quality of life. Also, there are intangible engineering factors which reduce the probability of a serious on-airport accident resulting from the design standards to be recommended in this report.

On balance the quality of life should increase in an isolated community, with the installation of an all-season airport. The benefits are constant across the various airport/aircraft combinations, since each combination provides year-round air access to the community. Benefits would vary with the size of community; this is to be analyzed further in Phase 3.

The safety of the pavement length should not be at issue, since the lengths shown in Table 9.1 meet the aircraft landing requirements and takeoff to 15.2 m (50 ft) above the end of the runway requirements. The width of the runway required is a function of the probability of a runoff and the cost if runoff occurs. As discussed in Chapter 3.0, there is a probability of one chance in two million that an aircraft will touchdown off a 15 m wide pavement. For the typical remote community of 400 population, there would be one runoff occurrence each 2,600 years, and even touching down 0.3 m to 0.5 m off the edge of the pavement is not expected to cause any damage to the aircraft, since they are capable of operating on turf.

9.4 Selection of a Recommended Airport/Aircraft Combination

Bearing in mind the main objective of the study is to develop reduced cost airport guidelines for remote areas, the recommended standard should provide reasonable access to typical aircraft serving remote areas. The B/C ratios in Table 9.1 are all positive and reasonably close to each other, except for the Citation II and the TC typical design. The Citation II provides a higher level of service (speed) that could have a marginal impact on emergency medical benefits (to be evaluated in Phase 3). However, it is considerably more expensive than the other airport/aircraft combinations. The TC typical design is included for comparison purposes with the remote airport design standard recommended here.

The runway lengths shown in Table 9.1 are determined on the basis of 22°C, 304.8 m (1000 ft) elevation, 0 slope and 0 wind. The runway lengths (excluding the Citation II and TC design) vary from 263 m (STOL reduced loading) to 525 m (C-185 full loading). A runway length of approximately 400 m (1300 ft) would allow all of the aircraft to operate into the community, albeit some with reduced loadings (DHC-6/CAR-3 and C-185). The Consultant believes that this length is too conservative, given the infrequency of the assumed operating conditions, i.e. 22°C, zero wind etc. Hence, the recommended runway length is 366 m (1200 ft) to reflect the more likely operating conditions of colder than 22°C and wind. See Appendix G for the detailed spreadsheet of incremental benefits and costs for the 366 m runway length and 7.6 m to 15.2 m runway width recommendations.

The potential capital cost savings of the above recommended remote airport design are substantial. Table 9.3, "Design Capital Cost Comparison for Recommended Remote Airport Design vs. TC Typical Remote Airport Design", illustrates these cost savings, i.e. $718,275 for a gravel pavement all-season remote airport.

This saving represents a 46 percent reduction in remote airport capital costs below the TC typical design for these airports. For a given remote airport's budget, 1.8 recommended design airports could be constructed for every TC typical design airport.

In the Phase 1 Report, the Consultant estimated the number of potential new airports required in the remote areas of Canada's provinces to be 171. Based on our findings in Phase 2, this figure of 171 should be reduced to 135 potential new airports. Multiplying this figure by the per airport saving of $718,275 yields a potential nationwide saving of $96,967,125.

The above analysis must not be considered as suggesting the present TC typical airports are over-built for the communities large enough to warrant service by the larger more economical (on a tonne-km/passenger-km) aircraft such as the HS-748. Rather the proposed designs are for the smaller remote communities.

	Recommended Design	TC Design
Strip Length	426 m	1,034 m
Graded Area Width	38 m	44 m
Runway Pavement Length	366 m	930 m
Runway Pavement Width	7.6 m to 15.2 m	23 m
Taxiway Length	40 m	40 m
Taxiway Width	7.5 m	10.5 m
Runway Cost (Gravel)	$252,530	$709,243
Taxiway Cost (Gravel)	$ 3,600	$ 5,040
Aircraft Apron Cost (Gravel)	$18,588	$ 18,588
Access Road	130,250	160,000
Car Park	1,200	1,200
ATB & Related Utilities	60,000	218,720
Mobile Equipment	310,000	310,000
Lighting & Navaids	78,505	150,157
Total Cost	$854,673	$1,572,948

Cost Savings of Recommended Design $718,275

Table 9.3 Design and Capital Cost Comparison for Recommended Remote Airport Design vs. TC Typical Remote Airport Design

APPENDIX A

Pavement Section Alternatives

Pavement Section Alternatives

1. Gravel Pavement

Constructed of granular aggregates, it employs conventional techniques for both the base and surface courses. This design depends on aggregate interlock particle friction and cohesion for stability. It can be used on all stable subgrade materials. The key requirement is the availability of aggregates having adequate stability and durability characteristics. The aggregate should be located close to the site. An adequate haul road is necessary.

For the aircraft under consideration, the thickness of pavement required is a minimum of 200 mm for most subgrade soils. The exceptions to this are: organic soils, which must be removed; silts(1) with high liquid limits, which require 600 mm of pavement; and clays with high liquid limits require 450 mm of pavement. As an alternative to providing a thicker granular pavement for a clay(1) subgrade, lime stabilization of the subgrade may be considered.

The equipment typically required for this type of construction consists of trucks to haul aggregate, a combination loader/backhoe, a water truck, a grader and a roller to compact the material. The construction procedure is as follows:

(a) The subgrade is shaped, cutting and filling as appropriate (if organic material exists in the subgrade this must be removed.) This operation is done with a grader except if major excavation is required, in which case a backhoe may be used.

(b) Subgrade soils are compacted using: a sheepsfoot or other heavy roller for clay soils and a vibratory roller for granular soils.

(c) Aggregate is hauled in from the closest source and spread on the subgrade. It may be necessary to screen and/or quarry and crush rock to produce local aggregate.

(d) The aggregate is graded and compacted, adding water to obtain optimum compaction.

Since this pavement is not designed for frost protection, depending on the frost susceptability of the subgrade, some heaving is likely to occur. This and other defects that occur through the life of the pavement can be corrected by regrading and occasionally adding more aggregate. Aggregate loss due to snow removal in the winter can be minimized by leaving about 5 cm of snow on the gravel surface and compacting this to act as a winter wearing surface.

The cost of this type of pavement if \$3 - 4.00 per square metre for a depth of 200 mm assuming an aggregate haul of 5 km. Any additional haul distances will result in higher cost by \$0.025 per square metre of pavement for every kilometer above the assumed 5 km haul distance.(2,3)

2. Portland Cement Soil-Cement Pavement

This pavement is economically constructed of cohesionless soils mixed with Portland Cement and water to form a durable structural layer with slab-like properties. A bituminous surface treatment is applied to this soil-cement base to form a wearing surface. Some clay content is allowable. Clay increases the difficulty of mixing and requires higher cement content. Organic material is unacceptable and must be removed or avoided. Soil cement is ideal for locations where proper aggregates are not available and must be brought in from a great distance, or require the construction of expensive new roads.

For the aircraft under consideration, the thicknesses of pavement, typical cement contents and approximate costs are shown for different subgrade conditions and soil types in Table A.1, "Soil Cement Pavement Requirements". These thicknesses are based on design curves in Reference 4.

Table A.1

Soil-Cement Pavement Requirements

Soil used for Soil Cement	Soil Cement Pavement	Subgrade Bearing Modulus 54 MPa/m (sandy soil)	14 MPa/m (silts & clays)
Granular Materials (35% or less passing 160 mm sieve)	Thickness (mm)	137	155
	Cement Content (kg/m^3)	100	100
	Cost (\$/m^2)	4.50	
		5.00	
Silty Clay Materials (More than 35% passing 160 mm sieve)	Thickness (mm)	145	164
	Cement Content (kg/m^3)	140	140
	Cost (\$)*	5.50	6.30

* excluding clearing, grubbing and grading, but including a bituminous surface treatment.

Source: Ref. 4, 5

The minimum amount of equipment required to construct a soil cement pavement is a grader, a water truck, a combination loader/backhoe a disc harrow or roto tiller, a roller, and bitumen distributor. If getting equipment to the site is not a problem, the disc harrow or roto tiller can be replaced by a transverse-shaft-type or windrow-type pugmill which would mix the soil cement as it travelled along the subgrade. To reduce the amount of equipment required some of the operations can be carried out manually. To this end, the suggested construction procedure is as follows:

(a) The subgrade is shaped, cutting and filling as appropriate. (If organic material exists in the subgrade this must be removed.) This operation is done with a grader except if major excavation is required in which case a backhoe may be used.

(b) The soil to be used pulverized, and graded into windrows.

(c) Cement is measured and spread manually by laying out bags or piles of bulk cement.

(d) The cement is then dry mixed with the soil using a disc harrow or tiller.

(e) Water is applied to bring the mixture to the optimum moisture content or slightly higher and mixing continued.

(f) Compaction is begun immediately after mixing is completed. Various types of rollers can be used depending on the soil type.

(g) Once compaction is completed the base is fine graded and rolled again.

(h) A bituminous surface treatment is applied to the soil cement surface to ensure adequate curing and provide a smooth wearing surface.

This pavement has not been designed for frost, therefore, some heaving or breakup may occur. Due to the ease of repair, such costs can be kept to a minimum by designing with the lowest practical cement content so that broken material can be regraded and patched.

3. Soil-Bitumen Soil-Cement Pavement

The construction of soil-bitumen pavement is very similar to that of Portland Cement soil-cement pavement except that bitumen is used to stabilize the soil instead of Portland Cement. Most of the same soil materials can be used, except for fine grained soils, which will not mix well with bitumen. Cut back type bitumens or emulsions should be used, choosing the curing rate depending on soil type and construction conditions. About 170 mm of pavement depth will be required. This is about 14% more than the average design thickness for Portland Cement soil-cement based on the equivalency factors listed in Reference 4. The bitumen content should be between 4% and 10%, thus the cost of this type of soil cement is \$5 - \$10 per square metre.(2,3)

The process used to construct bitumen soil-cement is essentially the same as for Portland Cement soil-cement, and uses the same equipment, except that the mixture is aerated between mixing and compaction. Also, no bituminous surface treatment is necessary when using bitumen soil cement.

This pavement has not been designed for frost, therefore, some heaving may occur. Breakup is expected to be minimal, since the pavement is semi-rigid. By designing with the lowest practical bitumen content with slowest practical curing rate the ease of repair can be kept to a minimum.

4. Aggregate-Turf Pavement

Aggregate-turf pavement consists of a mixture of coarse single-sized aggregate mixed with the native material, which is subsequently seeded to provide a grass surface. This addition of aggregate results in a turf landing area which will not soften in wet weather. This type of pavement is applicable where the aggregate is available and the native material is relatively stable soil. The exact material requirements in terms of aggregate turf mix must be determined based on testing of the native soil (sand, silt or clay). A typical turf aggregate pavement for subgrade or most subgrade soils would require about 200 mm of pavement. With 50% aggregate this pavement would cost approximately \$2.50 - \$3.50 per square metre assuming that the aggregate was hauled 5 kilometres.(2,3)

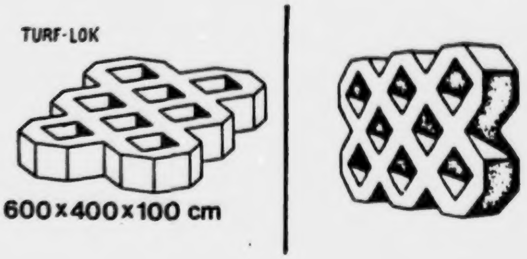
This type of construction requires equipment similar to that used for a soil cement pavement except that trucks are required to haul in aggregate and a bitumen distributor is not required. The construction procedure is also similar to that used for soil cement except that aggregate is mixed with the soil instead of cement and the surface is seeded instead of applying a bituminous layer.

This pavement is not designed for frost, thus some heaving may occur during spring thaw. This can be corrected relatively easily by grading, but adjusted areas must be reseeded or sodded.

5. Screen Stone Paving Block Pavement

This pavement consists of a surface made of prefabricated screen-stone units such as shown in Figure A.1, "Screen-Stone Paving Block". The voids in the stones are filled with top soil and seeded so that the grass will grow in between and hold the stone in place. For all subgrade soils except silts and clays with high liquid limits and organic soils which must be removed, these paving stones can be used as a pavement structure and wearing surface. For clays and silts with high liquid limits, additional strengthening of the pavement is necessary. This can be achieved by placing granular material beneath the stones or stabilizing the subgrade.

Figure A.1
Screen-Stone Paving Block



Source: Ref. 6

When paving stone is used alone on top of the subgrade, it requires a bedding material such as sand beneath it. The bedding facilitates levelling of stones and eliminates stress concentrations which may occur due to large stones beneath the paving stone. The thickness of the bedding material is dependent on the smoothness of the shaped subgrade and the quantity of large stones at the surface. The cost of constructing this pavement with blocks placed on a minimal bedding on the subgrade is \$26 per square metre.(2,7)

Equipment required is a grader, water truck, a roller, combination loader/backhoe and dump trucks to move the stones on the site. The construction procedure is as follows:

(a) The subgrade is shaped cutting and filling as appropriate. (If organic material is present, this must be removed.) This operation is done with a grader except if major excavation is necessary, in which case a backhoe may be used.

(b) Subgrade soils are compacted using a vibratory roller.

(c) Depending on the subgrade smoothness and number of rocks present, a layer of bedding material such as sandy soil, may be placed on the compacted subgrade. This layer is not compacted.

(d) The paving stones are placed on the sand bed.

(e) Voids are filled with top soil to the top of the stone. The topsoil is subsequently seeded.

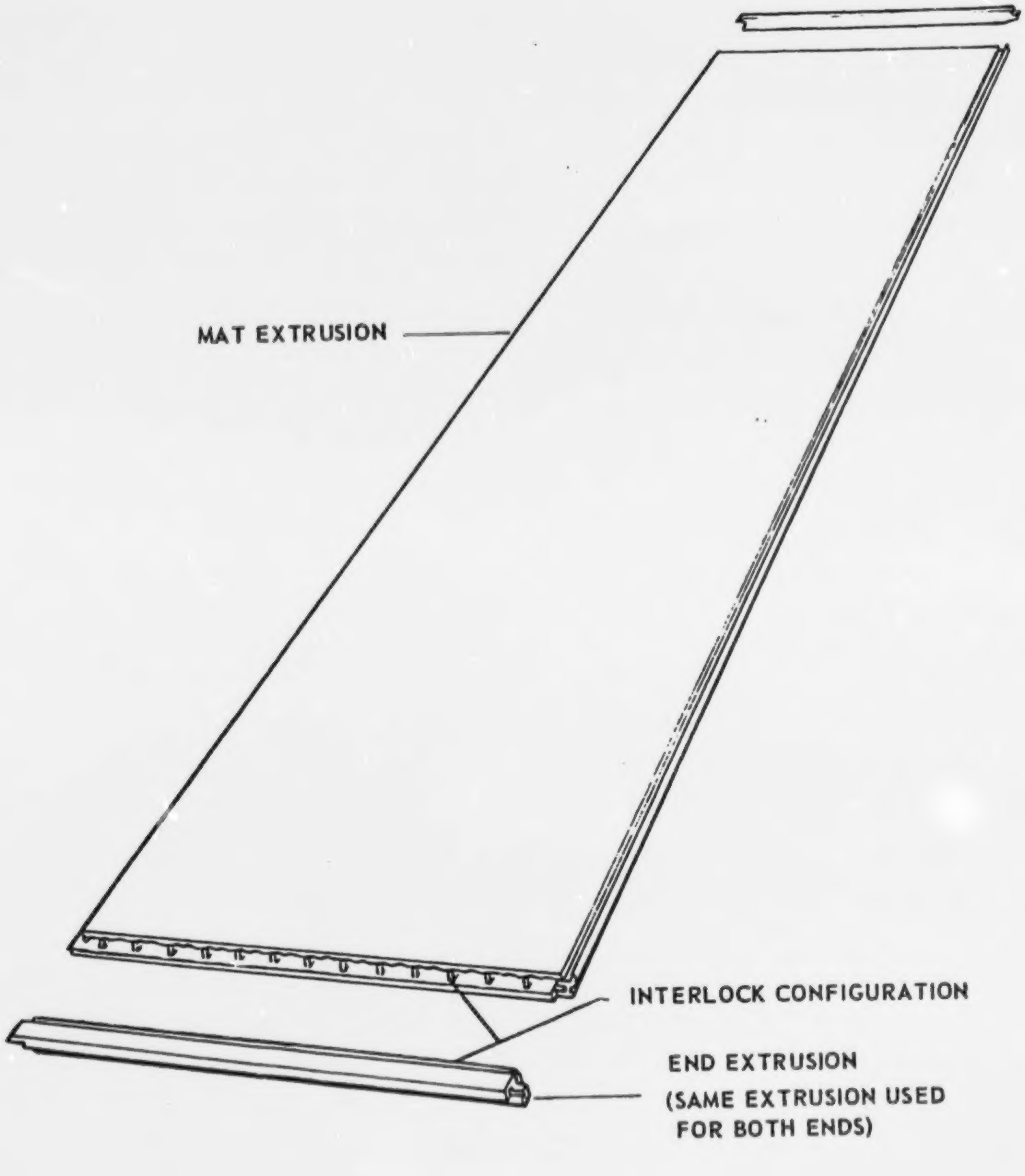
This pavement is expected to be relatively maintenance free. It is not, however, designed for frost protection; hence if frost susceptable materials exist in the subgrade, some heaving will occur. This can be corrected by manually removing the blocks in the area affected, adjusting the sand bed and relaying the blocks.

If considered as a self-help project, much of the work including manufacture of the paving blocks could be done locally. In most such intances little construction equipment would be required.

6. Aluminum Landing Mat Pavement

This pavement is constructed by placing prefabricated aluminum planks which are linked together and laid on the subgrade. One panel of this type of landing mat is illustrated in Figure A.2, "Exploded View of AM2 Aluminum Mat". The panel is hollow, with longitudinal ribs and hinge type connectors on all four sides. Such landing mats are currently in use by the US military for rapid runway construction. They are most applicable at sites where soils are poor and aggregates are not readily available.

Figure A.2
Exploded View of AM2 Aluminum Mat


MAT EXTRUSION
INTERLOCK CONFIGURATION
END EXTRUSION
(SAME EXTRUSION USED
FOR BOTH ENDS)

Source: Ref. 8

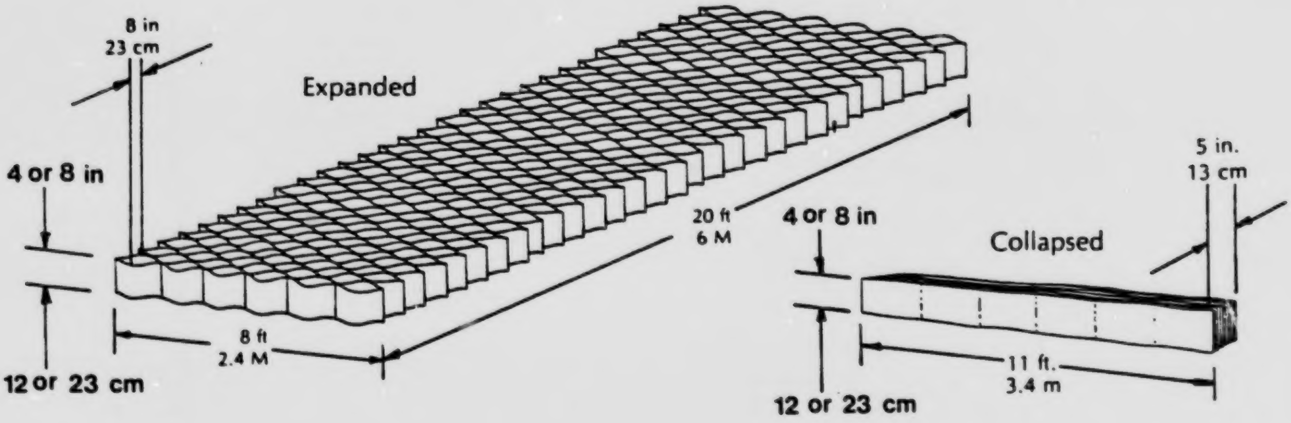
No materials other than the landing mat are generally necessary for this construction. The subgrade must be shaped, cutting and filling as necessary. Compacting is not normally necessary, however, depending on soil conditions, this may be preferrable. The minimum equipment requirements are therefore a grader and roller. The planks are laid on the subgrade, hinging them together. They are pinned down by anchors along the edges and ends of the pavement.

As the landing mats are currently used primarily by the military for the purposes of landing large jet aircraft with high tire pressures, even the lightest of these mats would be more than adequate for the small aircraft considered in this study. The cost of aluminum prefabricated pavement using planks similar to the AM2, in Figure A.2, would be about $71 per square metre, including transportation to a typical northern Manitoba site (800 km north of Winnipeg) by truck.(9,10) Some cost savings may be achieved if lighter mats of this type are found to be available when more detailed research is conducted.

7. Geoweb Pavement

Geoweb Pavement consists of a honeycomb type plastic lattice used to confine native soils and form a stable pavement structure. A commercially available polythylene lattice used for this purpose is illustrated in Figure A.3, "Geoweb Grid Confinement System". This type of construction would be used where high quality aggregates are not readily available. Provided they can be adquately compacted, existing soils on the site can be used to fill the lattice and form the pavement. The lattice would have to be imported to the site. However, as shown in Figure A.3 it can be collapsed to facilitate transportation.

Figure A.3
Geowed Grid Confinement System



Source: Ref. 11

This system has however been used successfully for numerous road and several airport projects with typical subgrade soil conditions. Where subgrade conditions are particularly poor consisting of organic soils, clays with high liquid limits, and silts with high liquid limits, other measures to increase bearing capacity must be used in combination with the Geoweb system. Other measures include chemical and lime stabilization of subsoils such as clays and silts as well as the use of geotextiles on organic subgrade soils.

The equipment typically required for this type of construction consists of a loader/backhoe to place material in the lattice, a water truck, a grader and a roller to compact the material. A backhoe may be required if extensive excavation is necessary. The construction procedure is as follows:

(a) The subgrade is shaped, cutting and filling as appropriate (if organic material exists in the subgrade this must be removed). This operation is done with a grader except if major excavation is required, in which case a backhoe may be used.

(b) Subgrade soils are compacted using: a vibratory roller for non clay or organic soils, a sheepsfoot or other heavy roller for clay soils.

(c) The lattice is placed on the subgrade and expanded by hand as shown in Figure A.4, "Placement of Geoweb". Each section of Geoweb is anchored by placing material inside the lattice along two edges.

(d) The rest of the lattice is filled using a front end loader, placing ample material 100-200 mm over the top of the lattice.

(e) The material is subsequently graded to leave about 100 mm over the top of the cells.

(f) Compaction is applied using a vibrating drum roller.

(g) After compaction the surface is further graded to within 25 mm above the top of the cells.

(h) A layer of asphalt emulsion is sprayed on the surface to form a wearing course.

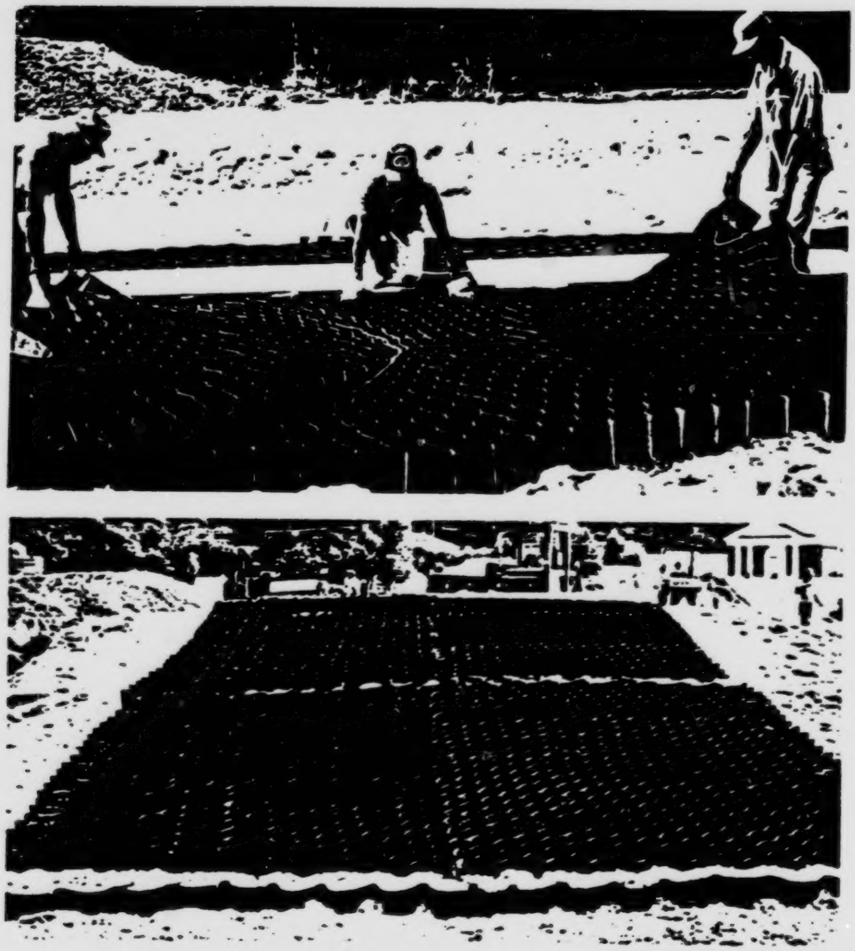
The cost of this type of pavement is \$11 - 12.00 per square metre using a 100 mm deep lattice and a bituminous surface treatment, which provides a granular equivalent depth of 150 to 200 mm.[2,12]

8. Subgrade Strengthening

Where subgrade soils are weak or unstable, options for strengthening the pavement subgrade include:

(a) removal of weak/unstable material and replacement with stable material;
(b) cement stablization of soil;
(c) chemical stabilization of soil; and

Figure A.4
Placement of Geoweb



Source: Ref. 11

(d) use of geotextiles placed on the subgrade under the pavement structure.

The above measures can generally be used in combination with any of the pavements described in sections 1 to 7. Some combinations such as cement or chemical stabilization of the subgrade and aggregate turf or the screen stone paving block pavement may be incompatible.

Replacement of the poor subgrade material with stable soil is effective where such stable soil is readily available. Where stable soil is not abundant or must be imported over a considerable distance, other means of strengthening such as cement or chemical stabilization or the use of geotextiles may be necessary.

The main materials used in cement stabilization include:

(a) Portland Cement;
(b) Bitumen;
(c) Lime; and
(d) Lime - Flyash Mixtures.

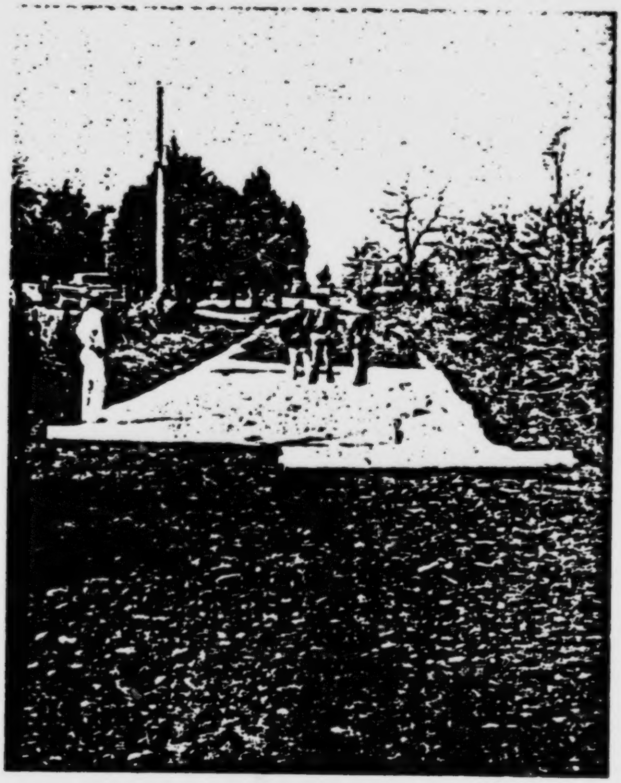
Application and cost of Portland Cement and bitumen as subbase stabilizers is similar to their applications to stablize base courses described in sections 2 and 3. Lime and lime-flyash mixtures are primarily applied to weak clay subgrades but can also be used with granular materials. Quantities of hydrated lime used range from 2 to 5% by weight. The cost of this type of subgrade treatment is \$2 - \$3 per square metre assuming a treatment depth of 200 mm.(2,3) A combination of lime and flyash with about 10 - 20% flyash will result in faster stablization. The addition of flyash in such large quantities however restricts its use to sites where abundant flyash is available at relatively low cost.

Numerous chemical soil stablizers can also be used to strengthen subgrade materials. Since these rely on specific chemical reactions with the soil, the soil chemistry must be determined by extensive testing before choosing the appropriate chemical. Generally since the chemicals are quite expensive, their use is only applicable under very specific conditions.

Geotextiles are a very versatile means for strengthening subgrades of all soil types including organic and silty soils. Figure A.5, "Placement of Geotextile" shows geotextile being rolled onto a subgrade and subsequently covered over with aggregate.

Geotextiles used for pavement stabilization are woven fabrics made from materials such as polypropylene. They are permeable to water but act as a separator between the pavement materials and the base course. They confine the pavement and distribute the load to the subgrade. By using geotextiles the base course thickness requirements can be reduced by 30 to 40%. This subgrade strengthening measure is relatively easy to apply since it only involves rolling the fabric over the subgrade. The cost is therefore made up primarily of the material cost which varies from about $0.50 to $1.50 per square metre of geotextile.(13)

Figure A.5
Placement of Geotextile



Source: Ref. 14

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APPENDIX B

Air Passenger and Cargo Demand - Regression Analysis

```
=====================================================================================================================
     AIRPORT          POP   A&D PAX ¦  PREDICTED Y    2.5%       97.5%   ¦
---------------------------------------------------------------------------------------------------------------------
 1 BERENS RIVER       996     7406 ¦    6856.573  -3520.902  17234.047 ¦       20 = N
 2 BLOODVEIN          417     7886 ¦    3246.222  -41014.00  47506.445 ¦    18228 = SUM OF X
 3 BROCHET            553     6029 ¦    4094.249  -28371.96  36560.459 ¦   126581 = SUM OF Y
 4 CROSS LAKE        2357     8294 ¦   15343.080  -112550.2  143236.39 ¦ 27935072 = SUM OF X^2
 5 GOD'S LK. NARR.   1002    10568 ¦    6893.986  -3871.408  17659.380 ¦  1.5E+09 = SUM OF Y^2
 6 ILFORD             190      659 ¦    1830.765  -62296.35  65957.881 ¦  1.9E+08 = SUM OF X*Y
 7 ISLAND LAKE       2317    24073 ¦   15093.660  -109272.1  139459.51 ¦    911.4 = X MEAN
 8 LAC BROCHET        370     2970 ¦    2953.154  -45408.00  51314.313 ¦  6329.05 = Y MEAN
 9 LITTLE GR.RAPIDS   649     4743 ¦    4692.856  -19577.80  28963.517 ¦ 11322072 = SUM OF X^2 - ((Sum of X)^2)/N
10 NORWAY HOUSE      2859    18362 ¦   18473.298  -153709.6  190656.24 ¦  6.7E+08 = SUM OF Y^2 - ((Sum of Y)^2)/N
11 OXFORD HOUSE      1070     6338 ¦    7317.999  -8433.436  23069.435 ¦ 70598714 = SUM OF X*Y - (Sum of X)*(Sum of Y)/N
12 PIKWITONEI         201     1714 ¦    1899.355  -61262.36  65061.076 ¦
13 POPLAR RIVER       544     3279 ¦    4038.130  -29203.72  37279.982 ¦ 6.235493 = SLOPE B
14 PUKATAWAGAN       1134     1147 ¦    7717.071  -13222.31  28656.458 ¦ 646.0209 = INTERCEPT A
15 RED SUCKER LK.     367     3501 ¦    2934.447  -45688.76  51557.660 ¦ 0.812436 = R (coefficient of correlation)
16 ST THERESA PT.    1320     9255 ¦    8876.873  -27926.23  45679.976 ¦
17 SHAMATTAWA         522     4343 ¦    3900.949  -31240.55  39042.452 ¦
18 SOUTH INDIAN L.    842     2806 ¦    5896.307  -3560.355  15352.968 ¦ 3549.068 = SD of points about the fitted line
19 THICKET PORTAGE    198      960 ¦    1880.649  -61544.34  65305.640 ¦
20 YORK LANDING       320     2248 ¦    2641.379  -50091.17  55373.929 ¦
```

Table B-1 **Manitoba Remote Airport Arriving and Departing Passengers vs. Population - Linear Regression**

```
=======================================================================================================================
#     AIRPORT          POP  TOT AIRCR¦   PREDICTED Y    2.5%          97.5%    ¦
-----------------------------------------------------------------------------------------------------------------------
 1 BERENS RIVER        996     4666 ¦    2957.764     -3151.823      9067.352 ¦         20 = N
 2 BLOODVEIN           417     2155 ¦    1550.545    -28762.258     31863.348 ¦      18228 = SUM OF X
 3 BROCHET             553     2144 ¦    1881.084    -20208.856     23971.023 ¦      55043 = SUM OF Y
 4 CROSS LAKE         2357     3267 ¦    6265.580    -81909.062     94440.223 ¦   27935072 = SUM OF X^2
 5 GOD'S LK. NARR.    1002     3887 ¦    2972.347     -3448.912      9393.606 ¦  265312711 = SUM OF Y^2
 6 ILFORD              190      564 ¦     998.837    -43094.612     45092.286 ¦   77683702 = SUM OF X*Y
 7 ISLAND LAKE        2317    10990 ¦    6168.363    -79569.889     91906.615 ¦        911 = X MEAN
 8 LAC BROCHET         370     1420 ¦    1436.315    -31725.942     34598.572 ¦       2752 = Y MEAN
 9 LITTLE GR.RAPIDS    649     2734 ¦    2114.405    -14211.860     18440.670 ¦   11322073 = SUM OF X^2 - ((Sum of X)^2)/N
10 NORWAY HOUSE       2859     6536 ¦    7485.657   -111271.731    126243.044 ¦  113826119 = SUM OF Y^2 - ((Sum of Y)^2)/N
11 OXFORD HOUSE       1070     2556 ¦    3137.616     -7069.740     13344.973 ¦   27517512 = SUM OF X*Y - (Sum of X)*(Sum of Y)/N
12 PIKWITONEI          201     1091 ¦    1025.572    -42399.276     44450.420 ¦
13 POPLAR RIVER        544     2010 ¦    1859.210    -20773.385     24491.805 ¦      2.430 = SLOPE B
14 PUKATAWAGAN        1134      686 ¦    3293.164    -10665.022     17251.350 ¦    537.056 = INTERCEPT A
15 RED SUCKER LK.      367     1767 ¦    1429.024    -31915.203     34773.250 ¦      0.767 = R (coefficient of correlation)
16 ST THERESA PT.     1320     3445 ¦    3745.224    -21374.811     28865.259 ¦
17 SHAMATTAWA          522     1722 ¦    1805.740    -22154.481     25765.962 ¦
18 SOUTH INDIAN L.     842     1574 ¦    2583.478     -2767.255      7934.212 ¦   1614.977 = SD of points about the fitted line
19 THICKET PORTAGE     198      255 ¦    1018.281    -42588.907     44625.469 ¦
20 YORK LANDING        320     1574 ¦    1314.793    -34881.456     37511.043 ¦
```

Table B-2 **Manitoba Remote Airport Aircraft Movements vs. Population - Linear Regression**

```
==============================================================================================================================
   ¦                    POPULATION   CARGO   ¦                                  ¦
   ¦                                (100Lb=45Kg)¦                               ¦
 # ¦                         X         Y     ¦  PREDICTED Y    2.5%     97.5%  ¦
------------------------------------------------------------------------------------------------------------------------------
  1                        996    59285.000 ¦   542434.992  *********  *********¦                 23 = N
  2                        417    34240.000 ¦   368160.800  *********  *********¦              18228 = SUM OF X
  3                        553   668150.000 ¦   409095.671  *********  *********¦            9623795 = SUM OF Y
  4                       2357   104722.000 ¦   952084.688  *********  *********¦           27935072 = SUM OF X^2
  5                       1002   641630.000 ¦   544240.942  *********  *********¦     10627441943164 = SUM OF Y^2
  6                        190        0.000 ¦   299835.686  *********  *********¦        11687139027 = SUM OF X*Y
  7                       2317  1778984.000 ¦   940045.020  *********  *********¦            792.522 = X MEAN
  8                        370  1265450.000 ¦   354014.191  *********  *********¦         481189.725 = Y MEAN
  9                        649   265722.000 ¦   437990.874  *********  *********¦       13488985.739 = SUM OF X^2 - ((Sum of X)^2)/N
 10                       2859   888644.000 ¦  1103182.518  *********  *********¦ 6600597570197.719 = SUM OF Y^2 - ((Sum of Y)^2)/N
 11                       1070   555055.000 ¦   564708.377  *********  *********¦     4060072672.826 = SUM OF X*Y - (Sum of X)*(Sum of Y)/N
 12                        201    64616.000 ¦   303146.594  *********  *********¦
 13                        544    30910.000 ¦   406386.746  *********  *********¦            300.992 = SLOPE B
 14                       1134    41820.000 ¦   583971.845  *********  *********¦         242647.264 = INTERCEPT A
 15                        367   321395.000 ¦   353111.216  *********  *********¦              0.430 = R (coefficient of correlation)
 16                       1320   846490.000 ¦   639956.300  *********  *********¦
 17                        522  1706593.000 ¦   399764.928  *********  *********¦
 18                        842   272795.000 ¦   496082.271  *********  *********¦         506084.381 = SD of points about the fitted line
 19                        198     2863.000 ¦   302243.619  *********  *********¦
 20                        320    74430.500 ¦   338964.606  *********  *********¦
```

Table B-3 **Manitoba Remote Airport Cargo vs. Population - Linear Regression (Unadjusted Data)**

```
=================================================================================================================
 #  :         POPULATION   CARGO     :                                 :
    :                      (100Lb=45Kg):                               :
    :              X         Y       :  PREDICTED Y    2.5%     97.5%  :
-----------------------------------------------------------------------------------------------------------------
 1            996   59285.000 :   449459.110  *********  *********:
 2            417   34240.000 :   204676.995  *********  *********:                   18 = N
 3            553  668150.000 :   262173.312  *********  *********:                 9803 = SUM OF X
 4           1002  641630.000 :   451995.712  *********  *********:              3879402 = SUM OF Y
 5            190       0.000 :   108708.878  *********  *********:              8427869 = SUM OF X^2
 6            649  265722.000 :   302758.948  *********  *********:        2148179644739 = SUM OF Y^2
 7           1070  555055.000 :   480743.870  *********  *********:           3418712103 = SUM OF X*Y
 8            201   64616.000 :   113359.315  *********  *********:              544.611 = X MEAN
 9            544   30910.000 :   258368.409  *********  *********:           258626.767 = Y MEAN
10           1134   41820.000 :   507800.961  *********  *********:          3089046.278 = SUM OF X^2 - ((Sum of X)^2)/N
11            367  321395.000 :   183538.644  *********  *********:  1312082089283.570 = SUM OF Y^2 - ((Sum of Y)^2)/N
12           1320  846490.000 :   586435.630  *********  *********:       1305946941.639 = SUM OF X*Y - (Sum of X)*(Sum of Y)/N
13            842  272795.000 :   384352.986  *********  *********:
14            198    2863.000 :   112091.014  *********  *********:              422.767 = SLOPE B
15            320   74430.500 :   163668.593  *********  *********:            28383.141 = INTERCEPT A
                                                                                   0.649 = R (coefficient of correlation)

                                                                              217940.756 = SD of points about the fitted line
```

Table B-4 Manitoba Remote Airport Cargo vs.
Population - Linear Regression
(Data Adjusted Extreme Points Omitted)

APPENDIX C

Hospital Separation Rates

Hospital Separation Rates
per 100,000 population
1979-80

Injury/Poisonings	M	1,670
	F	1,107
Birth Trauma	M	1
	F	-
Intrauterine Hypoxia, Birth Asphyxia, Other Respiratory Conditions	M	8
	F	5
Complications in Labour & Delivery	M	-
	F	1,066
Appendicitis	M	160
	F	126
Intracerebral and Intracranial Haemorrhage	M	22
	F	22
Acute Myocardial Infraction	M	272
	F	128
Salmonella Infections, Other Food Poisonings (Bacteria)	M	11
	F	10
Totals	M	2,144
	F	2,464

Average 2,304/100,000
population or .02304

Source: Hospital Morbidity, 1979-80/1980-81,
Catalogue No. 82-206, July 1984,
Statistics Canada

APPENDIX D

User Time Saving Calculations

The twelve communities identified as requiring construction of new or upgraded airports are used to estimate average trip time savings. Expected annual arriving/departing passengers at each of these communities is predicted using the regression equation developed in Chapter 6. Due to inconsistent derived passenger volumes for low population inputs (the zero-population figure yields 646 passengers) the regression equation is not used for populations less than 150. A quick examination of historical passenger figures at 20 Manitoba sites yields a rough average of 6.9 annual passengers per capita. This average is applied for sites with populations less than 150.

Aircraft type to serve the estimated passenger demand is chosen by calculating weekly round trips required by either Cessna 185 or DHC-6 type aircraft (the Cessna Citation is not considered as it is too expensive to operate as a regional scheduled aircraft). The Cessna 185 type aircraft is chosen to service the demand if seven or less flights per week are required, otherwise the DHC-6 is chosen. Annual predicted passenger volumes and number of flights required for each aircraft type are presented in Table D-1.

Calculation of trip times via air mode and competing ground modes can not be based on an extensive network of destinations, due to limitations of data. Hence, for calculation of net trip time savings it is assumed that every trip made is between a remote community and its "hub" (Winnipeg or Thompson). Estimates of ground mode trip times were based on average speeds (including stops) as per the Phase 1 analysis:

i) paved road - 60 km/hr
ii) gravel road - 50 km/hr
iii) other road - 20 km/hr

However, where bus schedule information was available, ground mode trip times were taken directly from the schedules. One-way trip times are presented in Table D-2, "Comparison of One-way Trip Times". Differences in trip times between new air service and the most likely scheduled competitor, bus, are given in the Table.

Community	Pop'n	Annual Arr/Dep. Passngrs	C-185(1)		DHC-6(2)		
			Annual	Weekly (Ave.)	Annual	Weekly (Ave.)	Monthly (Ave.)
1. Paunigassi	266	2,303	288	5-6(5.5)	72	1-2(1.3)	6
2. Split Lake	1,036	6,454	806	15-16(15.5)	202	3-4(3.9)	16-17(16.8)
3. Dauphin River	97	669	84	1-2(1.6)	21	(0.4)	1-2(1.75)
4. Wassagomach	660	4,758	595	11-12(11.4)	149	2-3(2.8)	12-13(12.4)
5. Grandville Lake	90	621	78	1-2(1.5)	19	-	1-2(1.6)
6. Jackhead 43	199	1,885	236	4-5(4.5)	59	1-2(1.1)	4-5(4.9)
7. Pelican Rapids	236	2,116	265	5	66	1-2(1.27)	5-6(5.5)
8. Pine Dock	105	725	91	13-14(13.9)	23	-	1-2(1.8)
9. The Narrows 49	452	3,462	433	8-9(8.3)	108	2	9
10. Wabowden	650	4,696	587	11-12(11.3)	147	2-3(2.8)	12-13(12.25)
11. Tadoule Lake	250	2,204	276	5-6(5.3)	69	1-2(1.3)	5-6(5.8)
12. Sherridon	167	1,686	210	4	53	1	4-5(4.4)

1. Assumed ave. 4 passengers/flight
2. Assumed ave. 16 passengers/flight

Table D-1 Annual Predicted Passenger Volumes & Required Flights

Source: R.S. Wallace & Associates Ltd.

Origin	Destination	New(1) Airport (standard wheelplane)	Existing(1) Air Service (amphibian/ skiplane)	Bus(2)	New Air Minus Bus	Privt(3) Auto	
1. Paunigassi	Winnipeg	1.9	2.0	-	-	10.8	(4)
2. Split Lake 171	Thompson	1.5	1.5	2.3	0.8	1.8	(5)
3. Dauphin River	Winnipeg	2.0	2.1	7.2	5.2	6.7	(5)
4. Wassagomach	Thompson	1.2	1.3	-	-	-	
5. Grandville Lake	Thompson	2.2	2.3	-	-	-	
6. Jackhead 43	Winnipeg	2.0	2.1	7.7	5.7	7.2	(5)
7. Pelican Rapids	Winnipeg	2.5	2.7	17.5	15.0	17.0	(5)
8. Pine Dock	Winnipeg	1.9	2.0	4.9	3.0	4.4	(5)
9. The Narrows 49	Winnipeg	1.8	1.9	4.8	3.0	4.3	(5)
10. Wabowden	Thompson	1.5	1.5	1.8	0.3	1.5	(5)
11. Tadoule Lake	Thompson	1.8	1.9	-	-	-	
12. Sherridon	Thompson	2.0	2.1	9.1	7.1	8.6	
				Ave.	5.0		

1. Includes 0.5 hr. terminal time at origin and destination.
2. Includes 0.25 hr. terminal time at origin and destination.
   Assumes no bus service to communities without paved or gravel roads.
3. Direct service.
4. Includes 150 km section of winter road.
5. Times taken from Bus Schedules (for portion of route served by bus), plus, where appropriate, time to travel from remote community to community where bus depot is located.

Source: R.S. Wallace & Associates Ltd.

Table D-2 Comparison of One-Way Trip Times (hours)

APPENDIX E

Remote Commercial Air Service Direct Operating Cost Calculations for a Hypothethical Network

								ANNUAL COSTS (1985)			
Community	Dist (NM)	pop'n	Annual Pax Demand (A&D)	Weekly Two-Way Trips Req'd C-185	Weekly Two-Way Trips Req'd DHC-6	A/C TYPE REQUIRED	Annual Utilization (bl-hours)	Fuel Cost ($)	Maint Labour ($)	Parts ($)	Subtotals
Poplar River 16	183	544	4035	9.7	2.4	0	314.82	$61,784.75	$4,722.35	$19,402.57	$85,909.67
Berens River 13	146	770	5443	13.1	3.3	0	329.99	$64,866.78	$4,949.82	$22,128.99	$91,945.59
Bloodvein River 12	108	417	3244	7.8	1.9	0	168.62	$32,501.55	$2,529.24	$11,919.45	$46,950.23
Matheson Island	113	128	888	2.1	0.5	1	226.52	$7,760.81	$2,265.22	$4,530.42	$14,556.45
Paunigassi	140	266	2303	5.5	1.4	1	687.12	$23,508.56	$6,871.15	$10,306.73	$40,686.44
Dauphin River 48A	124	97	673	1.5	0.4	1	171.66	$5,881.24	$1,716.61	$3,433.22	$11,031.06
Jackhead 43	119	199	1886	4.5	1.1	1	480.87	$16,475.03	$4,808.71	$9,617.43	$30,901.17
Pelican Rapids	205	236	2116	5.1	1.3	1	996.42	$33,865.77	$9,964.15	$14,946.23	$58,776.15
Pine Dock	103	105	729	1.8	0.4	1	185.82	$6,366.29	$1,858.19	$3,716.37	$11,940.84
The Narrows 49	119	452	3462	8.3	2.1	0	179.95	$34,686.24	$2,699.25	$12,720.65	$50,106.14
Total		3214	24780				3741.78	$287,697.01	$42,384.68	$112,722.06	$442,803.75
Avg		321	2478				374.2				

Total DHC-6	993.38
Avg DHC-6	248.34
Total C-185	2748.40
Avg C-195	458.07

Legend:
DHC-6 = 0
C-185 = 1

DHC-6		C-185	
Depreciation	$201,434.76	Depreciation	$29,010.92
Crew (2 pilots @ $32,000)	$64,000.00	Crew (4 pilots @ $25,000)	$100,000.00
Insurance	$25,000.00	Insurance	$6,500.00
Annual DOC	$565,346.39	Annual DOC	$303,403.04
DOC/bl-hr	$569.12	DOC/bl-hr	$110.39

Total Annual DOC $868,749.43
Avg Total DOC/bl-hr $232.18

Table E-1 Communities to be served by WINNIPEG (Regular Passenger Service; Load Factor=80%)

Community	Dist (NM)	pop'n	Annual Pax Demand (A&D)	Weekly Two-Way Trips Req'd C-185	Weekly Two-Way Trips Req'd DHC-6	A/C TYPE REQUIRED	Annual Utilization (bl-hours)	Fuel Cost ($)	Maint Labour ($)	Parts ($)	Subtotals
Poplar River 16	183	544	4035	12.9	3.2	0	419.76	$82,379.66	$6,296.47	$25,870.09	$114,546.22
Berens River 13	145	770	5443	17.4	4.4	0	439.98	$86,489.04	$6,599.76	$29,505.32	$122,594.12
Bloodvein River 12	108	417	3244	10.4	2.6	0	224.82	$43,335.29	$3,372.31	$15,892.60	$62,600.30
Matheson Island	113	128	888	2.8	0.7	1	302.03	$10,347.74	$3,020.29	$6,040.58	$19,408.61
Pawnigassi	140	266	2303	7.4	1.8	0	186.17	$36,596.76	$2,792.61	$12,484.81	$51,874.18
Dauphin River 48A	124	97	673	2.2	0.5	1	228.88	$7,841.65	$2,288.81	$4,577.62	$14,708.09
Jackhead 43	119	199	1586	5.0	1.3	1	641.16	$21,966.71	$6,411.62	$12,823.24	$41,201.56
Pelican Rapids	205	236	2116	6.8	1.7	1	1328.55	$45,154.36	$13,285.54	$19,928.30	$78,368.20
Pine Dock	103	105	729	2.3	0.6	1	247.76	$8,488.38	$2,477.58	$4,955.16	$15,921.12
The Narrows 49	119	452	3462	11.1	2.8	0	239.93	$46,248.32	$3,599.00	$16,960.87	$66,808.19
Total		3214	24780				4259.06	$388,848.03	$50,143.98	$149,038.58	$588,030.59
Avg		321	2478				425.9				

ANNUAL COSTS (1985)

Total DHC-6 1510.68
Avg DHC-6 302.14

Total C-185 2748.38
Avg C-185 549.68

Avg. Ann Passeng per Capita 7.7
Avg. Ann Utiliz'n per Capita 1.33

Legend: DHC-6 = 0
C-185 = 1

DHC-6		C-185	
Depreciation	$306,331.57	Depreciation	$29,010.71
Crew (2 pilots @ $32,000)	$64,000.00	Crew (4 pilots @ $25,000)	$100,000.00
Insurance	$25,000.00	Insurance	$6,500.00
Annual DOC	$813,754.59	Annual DOC	$305,118.29
DOC/bl-hr	$538.67	DOC/bl-hr	$111.02

Total Annual DOC $1,118,872.88
Avg Total DOC/bl-hr $262.70

Table E-2 Communities to be served by WINNIPEG (Regular Passenger Service; Load Factor=60%)

Community	Dist (NM)	pop'n	Annual Pax Demand (A&D)	Weekly Two-Way Trips Req'd C-185	Weekly Two-Way Trips Req'd DHC-6	A/C TYPE REQUIRED	Annual Utilization (bl-hours)	ANNUAL COSTS (1985) Fuel Cost ($)	ANNUAL COSTS (1985) Maint Labour ($)	ANNUAL COSTS (1985) Parts ($)	ANNUAL COSTS (1985) Subtotals
Poplar River 16	163	544	4035	19.4	4.8	0	629.65	$123,569.50	$9,444.70	$38,805.14	$171,819.34
Berens River 13	146	770	5443	26.2	6.5	0	659.98	$129,733.57	$9,899.64	$44,257.98	$183,891.19
Bloodvein River 12	108	417	3244	15.6	3.9	0	337.23	$65,003.09	$5,558.47	$23,338.89	$93,900.46
Matheson Island	[illegible]	128	868	4.3	1.1	1	451.64	$15,531.62	$4,520.43	$9,160.86	$29,212.91
Paunigassi	140	266	2303	11.1	2.8	0	279.25	$54,995.14	$4,188.91	$18,727.21	$77,911.26
Dauphin River 48A	124	97	673	3.2	0.8	1	343.32	$11,762.47	$3,433.22	$6,866.44	$22,062.13
Jackhead 43	117	199	1886	9.1	2.3	0	196.04	$37,788.60	$2,940.62	$13,858.17	$54,586.90
Pelican Rapids	205	236	2116	10.2	2.5	0	403.42	$78,404.88	$6,051.24	$24,126.30	$108,582.42
Pine Dock	103	105	729	3.5	0.9	1	371.64	$12,732.58	$3,716.37	$7,432.74	$23,881.69
The Narrows 49	119	452	3462	16.6	4.2	0	359.90	$69,372.49	$5,398.49	$25,441.30	$100,212.28
Total		3214	24780				4033.47	$598,781.33	$54,662.10	$212,417.04	$865,860.47
Avg		321	2478				403.3				

Total DHC-6	2865.47
Avg DHC-6	409.35
Total C-185	1168.00
Avg C-185	389.33

Avg. Ann Passeng per Capita	7.7
Avg. Ann Utiliz'n per Capita	1.25

Legend: DHC-6 = 0
C-185 = 1

DHC-6	
Depreciation	$581,053.99
Crew (4 pilots @ $32,000)	$128,000.00
Insurance	$25,000.00
Annual DOC	$1,524,857.74
DOC/bl-hr	$532.15

C-185	
Depreciation	$12,328.91
Crew (2 pilots @ $25,000)	$50,000.00
Insurance	$6,500.00
Annual DOC	$143,885.63
DOC/bl-hr	$123.19

Total Annual DOC	$1,668,743.38
Avg Total DOC/bl-hr	$413.72

Table E-3 Communities to be served by WINNIPEG
(Regular Passenger Service; Load Factor=40%)

ANNUAL COSTS (1985)

Community	Dist (NM)	pop'n	Annual Pax Demand (A&D)	Weekly Two-Way Trips Req'd C-185	DHC-6	A/C TYPE REQUIRED	Annual Utilization (bl-hours)	Fuel Cost ($)	Maint Labour ($)	Parts ($)	Subtotals
God's Lake 23	135	892	6203	14.9	3.7	0	376.07	$78,734.77	$5,641.00	$25,219.02	$109,594.79
God's River	135	253	2222	5.3	1.3	1	662.95	$435.19	$6,629.53	$6,629.53	$13,695.26
Red Sucker Lake	173	327	2683	5.5	1.6	1	915.65	$602.56	$9,156.45	$9,156.45	$18,915.47
S. Indian Lake	70	842	5894	14.2	3.5	0	204.37	$39,738.14	$3,320.96	$16,668.17	$59,727.27
Ilford	75	190	1839	4.4	1.1	1	388.05	$267.84	$3,880.49	$3,880.49	$8,028.82
Shamattawa 1	189	522	3898	9.4	2.3	0	304.13	$63,569.81	$4,561.95	$18,743.53	$86,875.29
Thicket Portage	32	198	1830	4.5	1.1	1	236.51	$156.33	$2,365.09	$2,365.09	$4,886.50
Split Lake 171	59	1036	7166	17.1	4.3	0	246.29	$47,890.06	$4,002.23	$20,087.49	$71,979.78
Sherridon	119	167	1686	4.1	1.0	1	430.03	$283.33	$4,300.35	$4,300.35	$8,884.02
Massagomach	148	660	4758	11.4	2.9	0	298.44	$60,389.27	$4,326.62	$19,342.90	$84,058.79
Granville Lake	151	90	693	1.7	0.4	1	236.49	$155.63	$2,364.86	$2,364.86	$4,885.35
Wabowden	59	650	4696	11.3	2.9	0	162.88	$31,670.27	$2,646.72	$13,284.10	$47,601.09
Tadoule Lake	124	250	2204	5.3	1.3	1	561.89	$370.21	$5,618.93	$5,618.93	$11,608.06
Total	1470	6077	45744				5013.74	$324,264.40	$58,815.18	$147,660.90	$530,740.48
Avg	113	467	3519				385.7				

Total DHC-6	1582.17
Avg DHC-6	263.70
Total C-185	3431.57
Avg C-185	490.22

Legend: DHC-6 = 0
C-185 = 1

DHC-6		C-185	
Depreciation	$320,829.15	Depreciation	$36,222.12
Crew (2 pilots @ $32,000)	$64,000.00	Crew (5 pilots @ $25,000)	$125,000.00
Insurance	$25,000.00	Insurance	$6,500.00
Annual DOC	$859,666.15	Annual DOC	$238,625.61
DOC/bl-hr	$549.67	DOC/bl-hr	$69.54

Total Annual DOC $1,108,291.76 Check: $1,108,292
Avg Total DOC/bl-hr $221.05

Table E-4 Communities to be served by THOMPSON (Regular Passenger Service; Load Factor=80%)

ANNUAL COSTS (1985)

Community	Dist (NM)	pop'n	Annual Pax Demand (A&D)	Weekly Two-Way Trips Req'd C-185	Weekly Two-Way Trips Req'd DHC-6	A/C TYPE REQUIRED	Annual Utilization (bl-hours)	Fuel Cost ($)	Maint Labour ($)	Parts ($)	Subtotals
God's Lake 23	135	692	6203	19.9	5.0	0	501.42	$104,979.70	$7,521.33	$33,625.37	$146,126.39
God's River	135	252	2222	7.1	1.8	0	179.63	$37,607.42	$2,694.41	$12,045.79	$52,347.61
Red Sucker Lake	173	327	2583	8.6	2.2	0	248.20	$51,320.42	$3,722.95	$15,971.47	$71,014.84
S. Indian Lake	79	842	5892	18.9	4.7	0	272.49	$52,984.19	$4,427.95	$22,224.23	$79,636.37
Ilford	76	192	1830	5.7	1.5	1	517.40	$357.12	$5,173.99	$5,173.99	$10,705.09
Shamattawa 1	189	522	3892	12.5	3.1	0	405.51	$84,759.74	$6,082.60	$24,991.37	$115,833.71
Thicket Portage	32	198	1880	6.9	1.5	1	315.35	$208.44	$3,153.45	$3,153.45	$6,515.34
Split Lake 171	59	1036	7100	22.8	5.7	0	328.39	$63,853.41	$5,336.30	$26,763.32	$95,973.04
Sherridon	119	167	1686	5.4	1.4	1	573.28	$377.76	$5,733.79	$5,733.79	$11,845.37
Wassagomach	148	660	4758	15.2	3.8	0	384.59	$80,519.02	$5,768.83	$25,790.53	$112,078.38
Granville Lake	151	90	693	2.2	0.6	1	315.32	$207.50	$3,153.15	$3,153.15	$6,513.80
Wabowden	59	630	4696	15.0	3.8	0	217.17	$42,227.02	$3,528.96	$17,712.13	$63,468.11
Tadoule Lake	124	250	2204	7.1	1.8	0	152.71	$31,351.95	$2,290.72	$10,795.41	$44,438.08
Total	1476	6077	45744				4411.54	$550,753.70	$58,588.44	$207,153.94	$816,496.12
Avg	113	467	3519				339.3				

Total DHC-6	2690.10
Avg DHC-6	298.90
Total C-185	1721.44
Avg C-185	430.36

DHC-6

Depreciation	$545,492.56
Crew (4 pilots @ $32,000)	$128,000.00
Insurance	$25,000.00
Annual DOC	$1,479,409.09
DOC/bl-hr	$549.95

C-185

Depreciation	$15,170.73
Crew (3 pilots @ $25,000)	$75,000.00
Insurance	$5,500.00
Annual DOC	$135,250.33
DOC/bl-hr	$78.57

Total Annual DOC $1,614,659.42 Check: $1,614,659
Avg Total DOC/bl-hr $366.01

Legend: DHC-6 = 0
C-185 = 1

Table E-5 Communities to be served by THOMPSON (Regular Passenger Service; Load Factor=60%)

Community	Dist (NM)	pop n	Annual Pax Demand (A&D)	Weekly Two-Way Trips Req'd		A/C TYPE REQUIRED	Annual Utilization (bl-hours)	ANNUAL COSTS (1985)			
				C-185	DHC-6			Fuel Cost ($)	Maint Labour ($)	Parts ($)	Subtotals
God's Lake 23	135	892	6203	29.8	7.5	0	752.13	$157,469.54	$11,262.00	$50,438.05	$219,169.59
God's River	135	252	2222	10.7	2.7	0	269.44	$56,411.13	$4,041.61	$18,068.68	$78,521.42
Red Sucker Lake	173	327	2683	12.9	3.2	0	372.30	$75,980.62	$5,584.43	$23,957.21	$106,522.26
S. Indian Lake	70	842	5892	28.3	7.1	0	406.73	$79,476.28	$6,641.93	$23,336.34	$119,454.55
Ilford	76	190	1830	8.8	2.2	0	158.95	$31,652.67	$2,583.62	$12,101.26	$46,336.95
Shamattawa I	189	522	3898	18.7	4.7	0	608.25	$127,139.61	$9,123.90	$37,487.05	$173,750.56
Thicket Portage	32	198	1860	9.0	2.3	0	96.72	$18,266.78	$1,692.56	$6,939.64	$28,898.99
Split Lake 171	59	1036	7100	34.1	8.5	0	492.56	$95,780.11	$8,004.46	$40,174.98	$143,959.55
Sherridon	119	167	1686	8.1	2.0	0	175.32	$35,991.99	$2,629.75	$12,393.11	$51,014.85
Wassagomach	148	660	4758	22.9	5.7	0	576.88	$120,778.54	$8,653.25	$38,685.79	$169,117.58
Grandville Lake	151	90	693	3.3	0.8	1	472.97	$311.25	$4,729.73	$4,729.73	$9,779.70
Wabowden	59	650	4696	22.6	5.6	0	325.75	$63,340.53	$5,293.44	$26,568.20	$95,202.17
Tadoule Lake	124	250	2204	10.6	2.6	0	229.07	$47,027.92	$3,436.08	$16,193.11	$66,657.12
Total	1470	6077	45744				4939.11	$910,626.99	$73,696.15	$323,073.15	$1,307,396.29
Avg	113	467	3519				379.9				

Total DHC-6	4466.14
Avg DHC-6	372.18
Total C-185	472.97
Avg C-185	472.97

Legend: DHC-6 = 0
C-185 = 1

DHC-6		C-185	
Depreciation	$905,633.94	Depreciation	$4,992.49
Crew (6 pilots @ $32,000)	$192,000.00	Crew (1 pilot @ $25,000)	$25,000.00
Insurance	$25,000.00	Insurance	$6,500.00
Annual DOC	$2,420,259.53	Annual DOC	$46,263.19
DOC/bl-hr	$541.91	DOC/bl-hr	$97.81

Total Annual DOC $2,466,522.72 Check: $2,466,523
Avg Total DOC/bl-hr $499.39

Table E-6 Communities to be served by THOMPSON (Regular Passenger Service; Load Factor=40%)

APPENDIX F

Request for CASB Data Search

R. S. WALLACE & ASSOCIATES LTD.
Transportation Planners

P. O. Box 749, 5 Main Street, Manotick, Ontario, Canada K0A 2N0 - Tel. (613) 692-2501 - Cable: WALLCONSULT

14 December 1984 Our Ref: 1150

Mr. Michael Tyler
Superintendent of Safety Studies
Canadian Aviation Safety Board
P.O. Box 9120
Alta Vista Terminal
Ottawa, Ontario K1G 3T8

Dear Mr. Tyler:

We are conducting a study to develop guidelines for appropriate airport design, operation and maintenance in remote areas. To evaluate the safety aspects of this project, we would like to obtain data on accident frequency by cause for individual airports serving communities of less than 2000 population.

Ideally, we would like to be able to run a multiple regression analysis on the data comparing airport characteristics with accident frequency per airport movement.

Possible characteristics to test, where the airport is listed as a cause of the accident are:

- Runway Length
- Runway Width
- Approach Slope Clearance
- Pavement Type
- Pavement Condition
- Weather Condition
- Landing Aids (including communications)
- Aircraft Type
- Aircraft Malfunction
- Pilot Error

The project also seeks to place an economic cost on aviation accidents. Do you have any estimate of the average costs of aviation accident property damage? health care? lost life?

Please contact us regarding the availability of accident data related to the above parameters and information on the economic cost of accidents. I would welcome a call from you to discuss further clarification.

Thank you.

Yours very truly,

R.S. WALLACE & ASSOCIATES LTD.

Per: Richard Slocum
Senior Economist

RWS:lc

APPENDIX A

Accident Population Specification for CASB Data Breakdown

The accident statistics to be analyzed will have the following charactertistics: (CASB Code)

- Aircraft was a fixed-wing aeroplane. (0123, 0124)
- Maximim aircraft takeoff weight was less than 12,500 lbs. (0121)
- CAT I or lower (non-instrument) capability.
- Exclude Student Pilots from Accident Population. (0501)
- Accident was located within a northern zone of the Provinces of Canada boundaried on the West by 140° Long, East by 55° Long, North by 60° Lat. (except Quebec at 63° Lat.) and South by:
  - B.C. 53° Lat.
  - Alberta 55° Lat.
  - Sask. 53° Lat.
  - Man. 51° Lat.
  - Ontario and Quebec 49° Lat. (0106, 0107)
  - Labrador
- Accident was located on an aerodrome (1212) except for NDB sub-section, Appendix B.
- Run No. 1 for multiple engine fixed-wing aircraft (0203)
- Run No. 2 for single engine fixed-wing aircraft (0203)

APPENDIX B

Aircraft Accidents
per 100,000 hours or 10,000 hours
1976 to 1984
(For Accident Population defined in Appendix A)

Specified Conditions (CASB Code)	1976	1977	1978	1979	1980	1981	1982	1983	1984
Land Aerodrome Runway Length ≤ 457.2 m (1500 ft) (1302, 1306)									
Land Aerodrome Runway Length 457.2 m to 914.4 m 1500 ft to 3000 ft (1302, 1306)									
Water Aerodrome (1302)									
Land Aerodrome Accident Occurred within 1.6 km of Aerodrome Runway Length ≤ 914.4 m (3000 ft) A. With NDB in Use B. Without NDB in Use (1109)									
Land Aerodrome Runway Length ≤ 914.4 m (3000 ft) A. Runway width > 22.9 m (75 ft) B. Runway width ≤ 22.9 m (75 ft) (1307)									
Land Aerodrome Runway Length A. Runway Surface Type Concrete (B) or Asphalt (I) B. Runway Surface Type Macadam (A) C. Runway Surface Type Grass (C) or Dirt (D) D. Surface Type Gravel (F) (1322)									
Land Aerodrome Runway Length ≤ 914.4 m (3000 ft) A. Runway Surface Status Dry (K) or Snow-Dry (m) B. Runway Surface Status Snow-Compacted (P) C. Runway Surface Status Snow-Wet (N), Snow-Crested (I) and Snow-Slush (D)									

APPENDIX C

Aircraft Accident Costs
per 100,000 hours or 10,000 hours
1976 to 1984
(For Accident Reported in Appendix B)

	1976	1977	1978	1979	1980	1981	1982	1983	1984
Property Damage									
Personal Injury									
Fatality									
Total									

APPENDIX G

Airport/Aircraft Combinations
Summary of Costs and Benefits

TABLE 6.1
AIRPORT/AIRCRAFT COMBINATION--SUMMARY OF COSTS AND BENEFITS

FACILITIES COST SUMMARY
(non-instrument runway)

A/C: C-185
Temp: 22 C
Elev: 1000 ft
GTOW: 3000 lbs

a)

CIVIL WORKS			PAVEMENT TYPE (P)				
	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)	$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)	$262,737.06	$262,499.82	$262,871.38	$266,963.66	$357,680.87	$530,915.72	$287,425.06
Subtotals	$416,374.56	$412,474.82	$431,158.88	$442,576.16	$676,130.67	$1,178,990.72	$499,662.56
(strip length = 447 m.)							
(graded area width = 38 m.)							
(runway pavement width = 15.2 m. max to 7.6 m. min)							
(runway pavement length = 387 m.);gravel=	404 ;	turf=	420				
Civil works Subtotals: 1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
3+4+5 :	$284,924.56	$283,824.82	$268,508.88	$294,326.16	$418,680.87	$669,540.72	$323,412.56

b) AIR TERMINAL BUILDING AND RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,800.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	$15,000.00	5 yr.
5 ton truck	$40,000.00	10 yr.
Tractor - loader	$60,000.00	10 yr.
attachments	$25,000.00	10 yr.
Subtotal	$140,000.00	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$17,168.50
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$81,768.50

Grand Totals (PV)	$698,143.06	$694,243.32	$712,927.38	$724,344.66	$957,899.37	$1,460,759.22	$781,431.06

		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing		(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
	Constant $	$8,439.45	$8,235.54	$12,276.84	$12,276.84	$8,439.45	$0.00	$12,276.84
	PV	$3,253.75	$3,175.13	$1,723.62	$1,723.62	$3,253.75	$0.00	$1,723.62
f) O $ M	Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
	PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Emerg. Serv. DOC	Annual	$194.88	$194.88	$192.00	$192.00	$194.88	$192.00	$192.00
	PV	$1,659.13	$1,659.13	$1,634.61	$1,634.61	$1,659.13	$1,634.61	$1,634.61
h) Incremental Reg. Pass. Serv. DOC (60% LF)	Annual	$4,989.74	$4,989.74	$4,916.00	$4,916.00	$4,989.74	$4,916.00	$4,916.00
	PV	$42,480.65	$42,480.65	$41,852.86	$41,852.86	$42,480.65	$41,852.86	$41,852.86
i) Incremental A/C Accident Costs								
Risk Level 0	Annual	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00
	PV	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96
Risk Level 1 (1.5X)	Annual	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00
	PV	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88
Risk Level 2 (2X)	Annual	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00
	PV	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80
Risk Level 3 (3X)	Annual	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00
	PV	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 400)								
a) Emergency Health Care								
-lives saved (0.74/yr)	Annual	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00
	PV	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41
-permanent disabilities	Annual	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00
prevented (1.48/yr)	PV	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39
-temp disability-lost	Annual	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00
work days saved (23.2/yr)	PV	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41
b) Air Service User Time	Annual	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00
Savings (5,024 hrs/yr)	PV	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69

c) Employment (person-yrs)

-long term (annual)	-local	1.8						
	-rest of Manitoba	0						
	-rest of Canada	0						
	-total	1.8						
-short term direct:								
civil works	-local	2.20	2.18	2.27	2.33	3.57	2.96	2.63
	-rest of Manitoba	2.20	2.18	2.27	2.33	3.57	2.96	2.63
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	4.41	4.36	4.55	4.67	7.13	5.91	5.26
ATB	-local	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba	0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local	0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba	0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local	0.38	0.38	0.38	0.38	0.38	0.38	0.38
	-rest of Manitoba	1.63	1.64	1.61	1.61	1.64	1.61	1.61
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	2.01	2.03	1.99	1.99	2.03	1.99	1.99
SUBTOTAL	-local	3.20	3.18	3.26	3.32	4.56	3.95	3.62
	-rest of Manitoba	4.59	4.58	4.65	4.71	5.97	5.33	5.01
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	7.78	7.76	7.91	8.03	10.53	9.28	8.63

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.89	1.88	1.96	2.01	3.08	2.56	2.27
	-rest of Canada	1.98	1.96	2.05	2.11	3.22	2.68	2.38
	-total	3.88	3.84	4.01	4.12	6.29	5.24	4.65
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.03	0.04	0.03	0.03	0.03	0.03	0.03
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.05	0.05	0.05	0.05	0.05	0.05	0.05
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.31	2.30	2.38	2.43	3.50	2.98	2.69
	-rest of Canada	2.13	2.11	2.20	2.25	3.37	2.83	2.53
	-total	4.44	4.41	4.58	4.69	6.86	5.81	5.22
TOTAL SHORT TERM	-local	3.20	3.18	3.26	3.32	4.56	3.95	3.62
	-rest of Manitoba	6.90	6.88	7.03	7.14	9.46	8.31	7.70
	-rest of Canada	2.13	2.11	2.20	2.25	3.37	2.83	2.53
	-total	12.23	12.17	12.49	12.71	17.39	15.08	13.84
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,240,075.39	$1,236,097.02	$1,210,109.26	$1,221,526.54	$1,499,831.69	$1,956,217.48	$1,278,612.94
- Risk Level 1		$1,247,848.30	$1,243,869.94	$1,217,882.18	$1,229,299.46	$1,507,604.60	$1,963,990.40	$1,286,385.86
- Risk Level 2		$1,255,621.22	$1,251,642.86	$1,225,655.09	$1,237,072.37	$1,515,377.52	$1,971,763.32	$1,294,158.77
- Risk Level 3		$1,271,167.05	$1,267,188.69	$1,241,200.93	$1,252,618.21	$1,530,923.35	$1,987,309.15	$1,309,704.61
TOTAL PV INCREMENTAL BENEFITS		$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90
PVB/PVC (INCREMENTAL)								
- Risk Level 0		2.01943	2.02593	2.06944	2.05010	1.66969	1.28015	1.95857
- Risk Level 1		2.00685	2.01327	2.05623	2.03714	1.66108	1.27508	1.94673
- Risk Level 2		1.99443	2.00077	2.04319	2.02434	1.65256	1.27006	1.93504
- Risk Level 3		1.97004	1.97622	2.01760	1.99921	1.63578	1.26012	1.91207

TABLE 6.2
AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS

A/C: C-185
Temp: 22 C
Elev: 1000 ft
GTOW: 3350 lbs

(non-instrument runway)

a)

CIVIL WORKS	PAVEMENT TYPE (P)						
	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)	$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)	$320,990.03	$319,809.71	$320,473.50	$325,449.70	$436,683.57	$646,414.60	$350,330.70
Subtotals	$474,627.53	$469,784.71	$488,761.00	$501,062.20	$755,133.57	$1,294,489.60	$562,568.20

(strip length = 563 m.)
(graded area width = 38 m.)
(runway pavement width = 15.2 m. max to 7.6 m. min)
(runway pavement length = 503 m.);gravel= 525 ; turf= 547

Civil works Subtotals:		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
	1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
	3+4+5 :	$343,177.53	$341,134.71	$346,111.00	$352,812.20	$497,683.57	$785,039.60	$386,318.20

b) AIR TERMINAL BUILDING AND RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,800.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	$15,000.00	5 yr.
5 ton truck	$40,000.00	10 yr.
Tractor - loader	$60,000.00	10 yr.
attachments	$25,000.00	10 yr.
Subtotal	$140,000.00	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$20,126.50
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$84,726.50

Grand Totals (PV)	$759,354.03	$754,511.21	$773,487.50	$785,788.70	$1,039,860.07	$1,579,216.10	$847,294.70

		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing		(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
	Constant $	$10,283.87	$10,018.69	$14,928.60	$14,928.60	$10,283.87	$0.00	$14,928.60
	PV	$3,964.84	$3,862.61	$2,095.91	$2,095.91	$3,964.84	$0.00	$2,095.91
f) O $ M	Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
	PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental	Annual	$194.88	$194.88	$192.00	$192.00	$194.88	$192.00	$192.00
A/C Emerg. Serv. DOC	PV	$1,659.13	$1,659.13	$1,634.61	$1,634.61	$1,659.13	$1,634.61	$1,634.61
h) Incremental								
Reg. Pass. Serv. DOC	Annual	$4,989.74	$4,989.74	$4,916.00	$4,916.00	$4,989.74	$4,916.00	$4,916.00
(60% LF)	PV	$42,480.65	$42,480.65	$41,852.86	$41,852.86	$42,480.65	$41,852.86	$41,852.86
i) Incremental								
A/C Accident Costs								
Risk Level 0	Annual	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00
	PV	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96
Risk Level 1	Annual	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00
(1.5X)	PV	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88
Risk Level 2	Annual	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00
(2X)	PV	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80
Risk Level 3	Annual	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00
(3X)	PV	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 400)								
a) Emergency Health Care								
-lives saved (0.74/yr)	Annual	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00
	PV	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41
-permanent disabilities	Annual	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00
prevented (1.48/yr)	PV	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39
-temp disability-lost	Annual	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00
work days saved (23.2/yr)	PV	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41
b) Air Service User Time	Annual	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00
Savings (5,024 hrs/yr)	PV	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69

c) Employment (person-yrs)

-long term (annual)	-local	1.8						
	-rest of Manitoba	0						
	-rest of Canada	0						
	-total	1.8						
-short term direct:								
civil works	-local	2.51	2.49	2.58	2.64	3.99	3.26	2.96
	-rest of Manitoba	2.51	2.49	2.58	2.64	3.99	3.26	2.96
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	5.03	4.97	5.15	5.28	7.97	6.53	5.93
ATB	-local	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba	0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local	0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba	0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local	0.40	0.40	0.40	0.40	0.40	0.40	0.40
	-rest of Manitoba	1.72	1.74	1.70	1.70	1.74	1.70	1.70
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	2.12	2.14	2.10	2.10	2.14	2.10	2.10
SUBTOTAL	-local	3.52	3.50	3.58	3.65	5.00	4.27	3.97
	-rest of Manitoba	4.99	4.98	5.04	5.10	6.48	5.73	5.43
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	8.52	8.45	8.62	8.75	11.48	10.00	9.40

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.16	2.14	2.22	2.28	3.44	2.83	2.56
	-rest of Canada	2.26	2.24	2.33	2.39	3.59	2.96	2.68
	-total	4.42	4.37	4.55	4.66	7.03	5.79	5.24
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.04	0.04	0.04	0.04	0.04	0.04	0.04
	-rest of Canada	0.02	0.02	0.02	0.02	0.02	0.02	0.02
	-total	0.06	0.06	0.06	0.06	0.06	0.06	0.06
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.58	2.56	2.65	2.70	3.86	3.25	2.98
	-rest of Canada	2.41	2.39	2.48	2.53	3.74	3.11	2.83
	-total	4.99	4.95	5.12	5.24	7.61	6.36	5.81
TOTAL SHORT TERM	-local	3.52	3.50	3.58	3.65	5.00	4.27	3.97
	-rest of Manitoba	7.58	7.55	7.69	7.81	10.34	8.93	8.41
	-rest of Canada	2.41	2.39	2.48	2.53	3.74	3.11	2.33
	-total	13.51	13.43	13.75	13.99	19.09	16.36	15.21
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,301,997.45	$1,297,052.39	$1,271,041.68	$1,283,342.88	$1,582,503.48	$2,074,674.36	$1,344,848.88
- Risk Level 1		$1,309,770.36	$1,304,825.31	$1,278,814.59	$1,291,115.79	$1,590,276.40	$2,082,447.28	$1,352,621.79
- Risk Level 2		$1,317,543.28	$1,312,598.23	$1,286,587.51	$1,298,888.71	$1,598,049.32	$2,090,220.20	$1,360,394.71
- Risk Level 3		$1,333,089.11	$1,328,144.06	$1,302,133.34	$1,314,434.54	$1,613,595.15	$2,105,766.03	$1,375,940.54
TOTAL PV INCREMENTAL BENEFITS		$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90
PVB/PVC (INCREMENTAL)								
- Risk Level 0		1.92339	1.93072	1.97023	1.95135	1.58246	1.20706	1.86211
- Risk Level 1		1.91196	1.91922	1.95826	1.93960	1.57473	1.20255	1.85140
- Risk Level 2		1.90070	1.90786	1.94643	1.92799	1.56707	1.19808	1.84083
- Risk Level 3		1.87853	1.88553	1.92319	1.90519	1.55197	1.18923	1.82003

TABLE G.3
AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS

A/C: C-185
Temp: 15 C
Elev: 0 ft
GTOW: 3000 lbs

(non-instrument runway)

a)

CIVIL WORKS	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
	PAVEMENT TYPE (P)						
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)	$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)	$238,105.00	$238,243.71	$238,539.45	$242,258.35	$324,274.85	$482,127.40	$260,852.85
Subtotals	$391,742.50	$388,218.71	$406,826.95	$417,870.85	$642,724.85	$1,130,202.40	$473,090.35

(strip length = 398 m.)
(graded area width = 38 m.)
(runway pavement width = 15.2 m. max to 7.6 m. min)
(runway pavement length = 338 m.);gravel= 353 ; turf= 367

Civil works Subtotals:		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
	1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
	3+4+5 :	$260,292.50	$259,568.71	$264,176.95	$269,620.85	$385,274.85	$620,752.40	$296,840.35

b) AIR TERMINAL BUILDING AND RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,800.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	$15,000.00	5 yr.
5 ton truck	$40,000.00	10 yr.
Tractor - loader	$60,000.00	10 yr.
attachments	$25,000.00	10 yr.
Subtotal	$140,000.00	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$15,919.00
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$80,519.00

Grand Totals (PV)	$672,261.50	$668,737.71	$687,345.95	$698,389.85	$923,243.85	$1,410,721.40	$753,609.35

			Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing			(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
		Constant $	$7,659.54	$7,482.15	$11,156.70	$11,156.70	$7,659.54	$0.00	$11,156.70
		PV	$2,953.06	$2,884.67	$1,566.35	$1,566.35	$2,953.06	$0.00	$1,566.35
f) O $ M		Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
		PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Emerg. Serv. DOC		Annual	$194.88	$194.88	$192.00	$192.00	$194.88	$192.00	$192.00
		PV	$1,659.13	$1,659.13	$1,634.61	$1,634.61	$1,659.13	$1,634.61	$1,634.61
h) Incremental Reg. Pass. Serv. DOC (60% LF)		Annual	$4,989.74	$4,989.74	$4,916.00	$4,916.00	$4,989.74	$4,916.00	$4,916.00
		PV	$42,480.65	$42,480.65	$41,852.86	$41,852.86	$42,480.65	$41,852.86	$41,852.86
i) Incremental A/C Accident Costs									
	Risk Level 0	Annual	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00
		PV	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96
	Risk Level 1 (1.5X)	Annual	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00
		PV	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88
	Risk Level 2 (2X)	Annual	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00
		PV	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80
	Risk Level 3 (3X)	Annual	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00
		PV	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 400)								
a) Emergency Health Care								
-lives saved (0.74/yr)	Annual	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00
	PV	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41
-permanent disabilities	Annual	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00
prevented (1.48/yr)	PV	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39
-temp disability-lost	Annual	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00
work days saved (23.2/yr)	PV	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41
b) Air Service User Time	Annual	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00
Savings (5,024 hrs/yr)	PV	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69

c) Employment (person-yrs)

-long term (annual)	-local	1.8						
	-rest of Manitoba	0						
	-rest of Canada	0						
	-total	1.8						
-short term direct:								
civil works	-local	2.07	2.05	2.14	2.20	3.39	2.83	2.49
	-rest of Manitoba	2.07	2.05	2.14	2.20	3.39	2.83	2.49
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	4.14	4.11	4.28	4.40	6.78	5.65	4.98
ATB	-local	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba	0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local	0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba	0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local	0.37	0.38	0.37	0.37	0.38	0.37	0.37
	-rest of Manitoba	1.59	1.60	1.58	1.58	1.60	1.58	1.58
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	1.96	1.98	1.95	1.95	1.98	1.95	1.95
SUBTOTAL	-local	3.06	3.04	3.13	3.18	4.38	3.81	3.47
	-rest of Manitoba	4.42	4.41	4.48	4.54	5.75	5.16	4.83
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	7.48	7.45	7.61	7.72	10.12	8.97	8.30

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.78	1.77	1.85	1.90	2.92	2.45	2.15
	-rest of Canada	1.86	1.85	1.94	1.99	3.06	2.56	2.25
	-total	3.65	3.61	3.79	3.89	5.98	5.01	4.40
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.04	0.05	0.04	0.04	0.04	0.04	0.04
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.20	2.18	2.27	2.32	3.34	2.87	2.57
	-rest of Canada	2.01	1.99	2.08	2.14	3.21	2.71	2.40
	-total	4.21	4.18	4.35	4.45	6.55	5.57	4.97
TOTAL SHORT TERM	-local	3.06	3.04	3.13	3.18	4.38	3.81	3.47
	-rest of Manitoba	6.62	6.59	6.75	6.85	9.09	8.03	7.40
	-rest of Canada	2.01	1.99	2.08	2.14	3.21	2.71	2.40
	-total	11.69	11.63	11.96	12.17	16.67	14.55	13.27
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,213,893.14	$1,210,300.95	$1,184,370.57	$1,195,414.47	$1,464,875.48	$1,906,179.66	$1,250,633.97
- Risk Level 1		$1,221,666.05	$1,218,073.87	$1,192,143.48	$1,203,187.38	$1,472,648.40	$1,913,952.58	$1,258,406.88
- Risk Level 2		$1,229,438.97	$1,225,846.78	$1,199,916.40	$1,210,960.30	$1,480,421.32	$1,921,725.50	$1,266,179.80
- Risk Level 3		$1,244,984.80	$1,241,392.62	$1,215,462.23	$1,226,506.13	$1,495,967.15	$1,937,271.33	$1,281,725.63
TOTAL PV INCREMENTAL BENEFITS		$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90
PVB/PVC (INCREMENTAL)								
- Risk Level 0		2.06299	2.06911	2.11441	2.09483	1.70953	1.31375	2.00238
- Risk Level 1		2.04986	2.05591	2.10063	2.08135	1.70051	1.30842	1.99002
- Risk Level 2		2.03690	2.04287	2.08702	2.06799	1.69155	1.30313	1.97780
- Risk Level 3		2.01147	2.01729	2.06033	2.04176	1.67400	1.29267	1.95391

TABLE G.4
AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS

A/C: C-185
Temp: 15 C
Elev: 0 ft
GTOW: 3350 lbs

(non-instrument runway)

a)

CIVIL WORKS	PAVEMENT TYPE (P)						
	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)	$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)	$287,333.03	$286,687.73	$287,203.31	$291,668.97	$391,037.92	$579,704.04	$313,997.27
Subtotals	$440,970.53	$436,662.73	$455,490.81	$467,281.47	$709,487.92	$1,227,779.04	$526,234.77

(strip length = 496 m.)
(graded area width = 38 m.)
(runway pavement width = 15.2 m. max to 7.6 m. min)
(runway pavement length = 436 m.);gravel= 455 ; turf= 474

Civil works Subtotals:		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
	1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
	3+4+5 :	$309,520.53	$308,012.73	$312,840.81	$319,031.47	$452,037.92	$718,329.04	$349,984.77

b) AIR TERMINAL BUILDING AND RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,800.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	$15,000.00	5 yr.
5 ton truck	$40,000.00	10 yr.
Tractor - loader	$60,000.00	10 yr.
attachments	$25,000.00	10 yr.
Subtotal	$140,000.00	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$18,418.00
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$83,018.00

Grand Totals (FV)	$723,988.53	$719,680.73	$736,508.81	$750,299.47	$992,505.92	$1,510,797.04	$809,252.77

			Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing			(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
		Constant $	$9,218.21	$8,988.70	$13,396.98	$13,396.98	$9,218.21	$0.00	$13,396.98
		PV	$3,553.99	$3,465.50	$1,880.88	$1,880.88	$3,553.99	$0.00	$1,880.88
f) O $ M		Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
		PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Emerg. Serv. DOC		Annual	$194.88	$194.88	$192.00	$192.00	$194.88	$192.00	$192.00
		PV	$1,659.13	$1,659.13	$1,634.61	$1,634.61	$1,659.13	$1,634.61	$1,634.61
h) Incremental Reg. Pass. Serv. DOC (60% LF)		Annual	$4,989.74	$4,989.74	$4,916.00	$4,916.00	$4,989.74	$4,916.00	$4,916.00
		PV	$42,480.65	$42,480.65	$41,852.86	$41,852.86	$42,480.65	$41,852.86	$41,852.86
i) Incremental A/C Accident Costs									
	Risk Level 0	Annual	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00
		PV	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96
	Risk Level 1 (1.5X)	Annual	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00
		PV	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88
	Risk Level 2 (2X)	Annual	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00
		PV	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80
	Risk Level 3 (3X)	Annual	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00
		PV	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 400)								
a) Emergency Health Care								
-lives saved (0.74/yr)	Annual	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00
	PV	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41
-permanent disabilities	Annual	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00
prevented (1.48/yr)	PV	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39
-temp disability-lost	Annual	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00
work days saved (23.2/yr)	PV	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41
b) Air Service User Time	Annual	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00
Savings (5,024 hrs/yr)	PV	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69

c) Employment (person-yrs)

-long term (annual)	-local	1.8						
	-rest of Manitoba	0						
	-rest of Canada	0						
	-total	1.8						
-short term direct:								
civil works	-local	2.33	2.31	2.40	2.46	3.74	3.09	2.77
	-rest of Manitoba	2.33	2.31	2.40	2.46	3.74	3.09	2.77
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	4.67	4.62	4.80	4.93	7.49	6.17	5.55
ATB	-local	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba	0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local	0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba	0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local	0.39	0.39	0.39	0.39	0.39	0.39	0.39
	-rest of Manitoba	1.67	1.68	1.65	1.65	1.68	1.65	1.65
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	2.06	2.07	2.04	2.04	2.07	2.04	2.04
SUBTOTAL	-local	3.33	3.31	3.40	3.46	4.75	4.08	3.77
	-rest of Manitoba	4.76	4.75	4.81	4.87	6.18	5.50	5.18
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	8.09	8.06	8.21	8.33	10.93	9.58	8.95

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.01	1.99	2.07	2.13	3.23	2.67	2.39
	-rest of Canada	2.10	2.08	2.17	2.22	3.38	2.80	2.50
	-total	4.11	4.07	4.24	4.35	6.61	5.47	4.90
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.04	0.04	0.04	0.04	0.04	0.04	0.04
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.05	0.05	0.05	0.05	0.05	0.05	0.05
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.43	2.41	2.49	2.55	3.65	3.10	2.81
	-rest of Canada	2.25	2.23	2.32	2.37	3.53	2.95	2.65
	-total	4.68	4.64	4.81	4.92	7.18	6.04	5.47
TOTAL SHORT TERM	-local	3.33	3.31	3.40	3.46	4.75	4.08	3.77
	-rest of Manitoba	7.19	7.16	7.30	7.42	9.83	8.59	8.00
	-rest of Canada	2.25	2.23	2.32	2.37	3.53	2.95	2.65
	-total	12.77	12.70	13.02	13.25	18.11	15.62	14.42
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,266,221.09	$1,261,824.81	$1,235,847.95	$1,247,638.61	$1,534,738.49	$2,006,255.30	$1,306,591.91
- Risk Level 1		$1,273,994.01	$1,269,597.72	$1,243,620.87	$1,255,411.53	$1,542,511.41	$2,014,028.22	$1,314,364.83
- Risk Level 2		$1,281,766.93	$1,277,370.64	$1,251,393.79	$1,263,184.45	$1,550,284.32	$2,021,801.14	$1,322,137.75
- Risk Level 3		$1,297,312.76	$1,292,916.47	$1,266,939.62	$1,278,730.28	$1,565,830.16	$2,037,346.97	$1,337,683.58
TOTAL PV INCREMENTAL BENEFITS		$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90
PVB/PVC (INCREMENTAL)								
- Risk Level 0		1.97774	1.98463	2.02634	2.00719	1.63171	1.24822	1.91663
- Risk Level 1		1.96567	1.97246	2.01368	1.99476	1.62349	1.24340	1.90529
- Risk Level 2		1.95375	1.96047	2.00117	1.98249	1.61535	1.23862	1.89409
- Risk Level 3		1.93034	1.93690	1.97661	1.95839	1.59931	1.22917	1.87208

TABLE G.5
AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS

A/C: C-185
Temp: -18 C
Elev: 1000 ft
GTOW: 3000 lbs

FACILITIES COST SUMMARY
(non-instrument runway)

a)

CIVIL WORKS		PAVEMENT TYPE (P)						
		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
	unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)		$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)		$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)		$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)		$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)		$214,327.30	$214,692.32	$215,200.66	$218,561.42	$292,027.52	$435,330.44	$235,365.22
	Subtotals	$367,964.80	$364,667.32	$383,488.16	$394,173.92	$610,477.52	$1,083,405.44	$447,602.72
(strip length = 351 m.)								
(graded area width = 38 m.)								
(runway pavement width = 15.2 m. max to 7.6 m. min)								
(runway pavement length = 291 m.);gravel=		303	turf=	315				
Civil works Subtotals:	1+2	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
	3+4+5	$236,514.80	$236,017.32	$240,838.16	$245,923.92	$353,027.52	$573,955.44	$271,352.72

b) AIR TERMINAL BUILDING AND
RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,300.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	$15,000.00	5 yr.
5 ton truck	$40,000.00	10 yr.
Tractor - loader	$60,000.00	10 yr.
attachments	$25,000.00	10 yr.
Subtotal	$140,000.00	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$14,720.50
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$79,320.50

Grand Totals (PV)	$647,285.30	$643,987.82	$662,808.66	$673,494.42	$889,798.02	$1,362,725.94	$726,923.22

		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing		(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
	Constant $	$6,906.69	$6,758.55	$10,082.28	$10,082.28	$6,906.69	$0.00	$10,082.29
	PV	$2,662.80	$2,605.69	$1,415.51	$1,415.51	$2,662.80	$0.00	$1,415.51
f) O $ M	Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
	PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Emerg. Serv. DOC	Annual	$194.88	$194.88	$192.00	$192.00	$194.88	$192.00	$192.00
	PV	$1,659.13	$1,659.13	$1,634.61	$1,634.61	$1,659.13	$1,634.61	$1,634.61
h) Incremental Reg. Pass. Serv. DOC (60% LF)	Annual	$4,989.74	$4,989.74	$4,916.00	$4,916.00	$4,989.74	$4,916.00	$4,916.00
	PV	$42,480.65	$42,480.65	$41,852.86	$41,852.86	$42,480.65	$41,852.86	$41,852.86
i) Incremental A/C Accident Costs								
Risk Level 0	Annual	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00
	PV	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96
Risk Level 1 (1.5X)	Annual	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00
	PV	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88
Risk Level 2 (2X)	Annual	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00
	PV	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80
Risk Level 3 (3X)	Annual	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,970.00	$8,870.00	$8,870.00
	PV	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 400)								
a) Emergency Health Care								
-lives saved (0.74/yr)	Annual	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00
	PV	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41
-permanent disabilities	Annual	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00
prevented (1.48/yr)	PV	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39
-temp disability-lost	Annual	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00
work days saved (23.2/yr)	PV	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41
b) Air Service User Time	Annual	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00
Savings (5,024 hrs/yr)	PV	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69

c) Employment (person-yrs)

-long term (annual)	-local	1.8						
	-rest of Manitoba	0						
	-rest of Canada	0						
	-total	1.8						
-short term direct:								
civil works	-local	1.95	1.93	2.02	2.08	3.22	2.70	2.36
	-rest of Manitoba	1.95	1.93	2.02	2.08	3.22	2.70	2.36
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	3.89	3.86	4.04	4.15	6.44	5.40	4.71
ATB	-local	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba	0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local	0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba	0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local	0.37	0.37	0.36	0.36	0.37	0.36	0.36
	-rest of Manitoba	1.55	1.56	1.54	1.54	1.56	1.54	1.54
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	1.92	1.93	1.91	1.91	1.93	1.91	1.91
SUBTOTAL	-local	2.92	2.91	3.00	3.05	4.20	3.68	3.33
	-rest of Manitoba	4.25	4.25	4.32	4.38	5.54	5.00	4.66
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	7.18	7.15	7.32	7.43	9.73	8.68	7.99

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.67	1.66	1.74	1.79	2.78	2.34	2.04
	-rest of Canada	1.75	1.74	1.83	1.88	2.91	2.45	2.13
	-total	3.43	3.40	3.57	3.67	5.68	4.79	4.17
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.04	0.04	0.04	0.04	0.04	0.04	0.04
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.09	2.07	2.16	2.21	3.19	2.76	2.45
	-rest of Canada	1.90	1.88	1.97	2.02	3.05	2.60	2.28
	-total	3.99	3.96	4.13	4.23	6.24	5.35	4.73
TOTAL SHORT TERM	-local	2.92	2.91	3.00	3.05	4.20	3.68	3.33
	-rest of Manitoba	6.34	6.32	6.48	6.58	8.73	7.76	7.11
	-rest of Canada	1.90	1.88	1.97	2.02	3.05	2.60	2.28
	-total	11.16	11.11	11.44	11.66	15.98	14.03	12.71
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,188,626.68	$1,185,272.09	$1,159,682.43	$1,170,368.19	$1,431,139.40	$1,858,184.20	$1,223,796.99
- Risk Level 1		$1,196,399.60	$1,193,045.00	$1,167,455.35	$1,178,141.11	$1,438,912.31	$1,865,957.12	$1,231,569.91
- Risk Level 2		$1,204,172.51	$1,200,817.92	$1,175,228.27	$1,185,914.03	$1,446,685.23	$1,873,730.04	$1,239,342.83
- Risk Level 3		$1,219,718.35	$1,216,363.75	$1,190,774.10	$1,201,459.86	$1,462,231.06	$1,889,275.87	$1,254,888.66
TOTAL PV INCREMENTAL BENEFITS		$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90
PVB/PVC (INCREMENTAL)								
- Risk Level 0		2.10684	2.11281	2.15943	2.13971	1.74983	1.34769	2.04630
- Risk Level 1		2.09316	2.09904	2.14505	2.12559	1.74038	1.34207	2.03338
- Risk Level 2		2.07964	2.08545	2.13086	2.11166	1.73103	1.33651	2.02063
- Risk Level 3		2.05314	2.05880	2.10304	2.09434	1.71262	1.32551	1.99560

TABLE G.6
AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS

A/C: C-185
Temp: -18 C
Elev: 1000 ft
GTOW: 3350 lbs

(non-instrument runway)

a)		PAVEMENT TYPE (P)					
CIVIL WORKS	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,675.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)	$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)	$254,566.49	$254,338.67	$234,926.26	$258,896.62	$346,599.93	$514,984.84	$278,748.42
Subtotals	$408,203.99	$404,313.67	$423,213.76	$434,509.12	$665,049.93	$1,163,059.84	$490,985.92
(strip length = 431 m.)							
(graded area width = 38 m.)							
(runway pavement width = 15.2 m. max to 7.6 m. min)							
(runway pavement length = 371 m.);gravel=	387 ;	turf=	403				
Civil works Subtotals: 1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
3+4+5 :	$276,753.99	$275,663.67	$280,563.76	$286,259.12	$407,599.93	$653,609.84	$314,735.92

b) AIR TERMINAL BUILDING AND RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,800.00
Sewage Disposal	$1,500.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	$15,000.00	5 yr.
5 ton truck	$40,000.00	10 yr.
Tractor - loader	$60,000.00	10 yr.
attachments	$25,000.00	10 yr.
Subtotal	$140,000.00	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$16,760.50
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$81,360.50

Grand Totals (PV)	$689,564.49	$635,674.17	$704,574.26	$715,869.62	$946,410.43	$1,444,420.34	$772,346.42

			Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing			(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
		Constant $	$8,180.75	$7,988.73	$11,911.08	$11,911.08	$8,180.75	$0.00	$11,911.08
		PV	$3,154.01	$3,079.97	$1,672.27	$1,672.27	$3,154.01	$0.00	$1,672.27
f) O $ M		Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
		PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Emerg. Serv. DOC		Annual	$194.88	$194.88	$192.00	$192.00	$194.88	$192.00	$192.00
		PV	$1,659.13	$1,659.13	$1,634.61	$1,634.61	$1,659.13	$1,634.61	$1,634.61
h) Incremental Reg. Pass. Serv. DOC (60% LF)		Annual	$4,989.74	$4,989.74	$4,916.00	$4,916.00	$4,989.74	$4,916.00	$4,916.00
		PV	$42,480.65	$42,480.65	$41,852.86	$41,852.86	$42,480.65	$41,852.86	$41,852.86
i) Incremental A/C Accident Costs	Risk Level 0	Annual	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00
		PV	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96
	Risk Level 1 (1.5X)	Annual	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00
		PV	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88
	Risk Level 2 (2X)	Annual	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00
		PV	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80
	Risk Level 3 (3X)	Annual	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00
		PV	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 400)								
a) Emergency Health Care								
-lives saved (0.74/yr)	Annual	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00
	PV	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41
-permanent disabilities	Annual	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00
prevented (1.48/yr)	PV	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39
-temp disability-lost	Annual	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00
work days saved (23.2/yr)	PV	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41
b) Air Service User Time	Annual	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00
Savings (5,024 hrs/yr)	PV	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69

c) Employment (person-yrs)

-long term (annual)	-local	1.8						
	-rest of Manitoba	0						
	-rest of Canada	0						
	-total	1.8						
-short term direct:								
civil works	-local	2.16	2.14	2.23	2.29	3.51	2.91	2.59
	-rest of Manitoba	2.16	2.14	2.23	2.29	3.51	2.91	2.59
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	4.32	4.28	4.46	4.58	7.02	5.83	5.17
ATB	-local	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba	0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local	0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba	0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local	0.38	0.38	0.38	0.38	0.38	0.38	0.38
	-rest of Manitoba	1.61	1.63	1.60	1.60	1.63	1.60	1.60
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	1.99	2.01	1.98	1.98	2.01	1.98	1.98
SUBTOTAL	-local	3.15	3.13	3.22	3.28	4.50	3.90	3.57
	-rest of Manitoba	4.53	4.52	4.59	4.65	5.89	5.27	4.95
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	7.68	7.65	7.81	7.93	10.39	9.18	8.52

-short tera indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.86	1.84	1.93	1.98	3.03	2.53	2.23
	-rest of Canada	1.94	1.92	2.01	2.07	3.17	2.64	2.34
	-total	3.80	3.76	3.94	4.05	6.19	5.17	4.57
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.05	0.05	0.05	0.05	0.05	0.05	0.05
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.28	2.26	2.34	2.39	3.44	2.94	2.65
	-rest of Canada	2.09	2.07	2.16	2.22	3.31	2.79	2.48
	-total	4.37	4.33	4.50	4.61	6.76	5.73	5.14
TOTAL SHORT TERM	-local	3.15	3.13	3.22	3.28	4.50	3.90	3.57
	-rest of Manitoba	6.81	6.78	6.93	7.05	9.34	8.22	7.60
	-rest of Canada	2.09	2.07	2.16	2.22	3.31	2.79	2.48
	-total	12.05	11.99	12.31	12.54	17.15	14.91	13.66
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,231,397.07	$1,227,432.72	$1,201,704.79	$1,213,000.15	$1,488,243.01	$1,939,878.60	$1,269,476.95
- Risk Level 1		$1,239,169.99	$1,235,205.64	$1,209,477.71	$1,220,773.07	$1,496,015.92	$1,947,651.52	$1,277,249.87
- Risk Level 2		$1,246,942.90	$1,242,978.55	$1,217,250.62	$1,228,545.78	$1,503,788.84	$1,955,424.44	$1,285,022.78
- Risk Level 3		$1,262,488.74	$1,258,524.39	$1,232,796.46	$1,244,091.82	$1,519,334.67	$1,970,970.27	$1,300,568.62
TOTAL PV INCREMENTAL BENEFITS		$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90
PVB/PVC (INCREMENTAL)								
- Risk Level 0		2.03367	2.04023	2.08391	2.06451	1.68269	1.29093	1.97266
- Risk Level 1		2.02091	2.02740	2.07052	2.05136	1.67395	1.28578	1.96066
- Risk Level 2		2.00831	2.01472	2.05730	2.03839	1.66529	1.28067	1.94880
- Risk Level 3		1.98352	1.98983	2.03136	2.01291	1.64825	1.27057	1.92550

TABLE 6.7
AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS

A/C: DHC-6
Temp: 22 C
Elev: 1000 ft
GTOW: 10000 lbs
STOL

(non-instrument runway)

a)

CIVIL WORKS	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
	PAVEMENT TYPE (P)						
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)	$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)	$195,186.73	$193,081.42	$199,310.42	$202,427.34	$266,069.07	$403,468.68	$218,011.94
Subtotals	$348,824.23	$343,056.42	$367,597.92	$378,039.84	$584,519.07	$1,051,543.68	$430,249.44

(strip length = 319 m.)
(graded area width = 38 m.)
(runway pavement width = 15.2 m. max to 7.6 m. min)
(runway pavement length = 259 m.);gravel= 263 ; turf= 268

Civil works Subtotals:		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
	1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
	3+4+5 :	$217,374.23	$214,406.42	$224,947.92	$229,789.84	$327,069.07	$542,093.68	$253,999.44

b) AIR TERMINAL BUILDING AND RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,800.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachments	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$13,904.50
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$78,504.50

Grand Totals	$627,328.73	$621,560.92	$646,102.42	$656,544.34	$663,023.57	$1,330,048.18	$708,753.94

		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing		(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
	Constant $	$6,300.65	$6,367.46	$9,350.76	$9,350.76	$6,300.65	$0.00	$9,350.76
	PV	$2,429.15	$2,454.91	$1,312.81	$1,312.81	$2,429.15	$0.00	$1,312.81
f) O & M	Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
	PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Emerg. Serv. DOC	Annual	$189.81	$189.81	$187.00	$187.00	$189.81	$187.00	$187.00
	PV	$1,615.92	$1,615.92	$1,592.04	$1,592.04	$1,615.92	$1,592.04	$1,592.04
h) Incremental Reg. Pass. Serv. DOC (60% LF)	Annual	$3,731.14	$3,731.14	$3,676.00	$3,676.00	$3,731.14	$3,676.00	$3,676.00
	PV	$31,765.43	$31,765.43	$31,295.99	$31,295.99	$31,765.43	$31,295.99	$31,295.99
i) Incremental A/C Accident Costs								
Risk Level 0	Annual	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00
	PV	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96
Risk Level 1 (1.5X)	Annual	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00
	PV	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88
Risk Level 2 (2X)	Annual	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00
	PV	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80
Risk Level 3 (3X)	Annual	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00
	PV	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 400)								
a) Emergency Health Care								
-lives saved (0.74/yr)	Annual	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00
	PV	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41
-permanent disabilities	Annual	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00
prevented (1.48/yr)	PV	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39
-temp disability-lost	Annual	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00
work days saved (23.3/yr)	PV	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41
b) Air Service User Time	Annual	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00
Savings (5,024 hrs/yr)	PV	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69

c) Employment (person-yrs)

-long term (annual)	-local	1.8							
	-rest of Manitoba	0							
	-rest of Canada	0							
	-total	1.8							
-short term direct:									
civil works	-local		1.84	1.81	1.94	1.99	3.08	2.62	2.27
	-rest of Manitoba		1.84	1.81	1.94	1.99	3.08	2.62	2.27
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		3.69	3.63	3.87	3.98	6.16	5.23	4.53
ATB	-local		0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba		0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local		0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba		0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-totai		1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local		0.36	0.36	0.36	0.36	0.36	0.36	0.36
	-rest of Manitoba		1.52	1.53	1.52	1.52	1.53	1.52	1.52
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.89	1.90	1.88	1.88	1.90	1.88	1.88
SUBTOTAL	-local		2.82	2.79	2.91	2.96	4.05	3.59	3.24
	-rest of Manitoba		4.13	4.10	4.21	4.27	5.37	4.89	4.54
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		6.94	6.89	7.12	7.23	9.43	8.48	7.78

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.59	1.56	1.67	1.72	2.66	2.27	1.96
	-rest of Canada	1.66	1.63	1.75	1.80	2.78	2.37	2.05
	-total	3.25	3.19	3.42	3.52	5.44	4.64	4.01
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.04	0.04	0.04	0.04	0.04	0.04	0.04
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.00	1.97	2.08	2.13	3.07	2.68	2.37
	-rest of Canada	1.81	1.78	1.89	1.94	2.93	2.52	2.19
	-total	3.80	3.75	3.98	4.08	6.00	5.20	4.56
TOTAL SHORT TERM	-local	2.82	2.79	2.91	2.96	4.05	3.59	3.24
	-rest of Manitoba	6.13	6.08	6.30	6.40	8.44	7.57	6.91
	-rest of Canada	1.81	1.78	1.89	1.94	2.93	2.52	2.19
	-total	10.75	10.64	11.10	11.30	15.43	13.68	12.34
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,157,678.04	$1,151,935.58	$1,132,274.06	$1,142,715.93	$1,393,372.87	$1,814,907.01	$1,194,925.58
- Risk Level 1		$1,165,450.95	$1,159,708.90	$1,140,046.98	$1,150,488.90	$1,401,145.79	$1,822,679.93	$1,202,698.50
- Risk Level 2		$1,173,223.87	$1,167,481.82	$1,147,819.87	$1,158,261.81	$1,408,918.71	$1,830,452.85	$1,210,471.41
- Risk Level 3		$1,188,769.70	$1,183,027.65	$1,163,365.73	$1,173,807.67	$1,424,464.54	$1,845,998.68	$1,226,017.25
TOTAL PV INCREMENTAL BENEFITS		$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90
PVB/PVC (INCREMENTAL)								
- Risk Level 0		2.16316	2.17395	2.21170	2.19149	1.79725	1.37982	2.09574
- Risk Level 1		2.14874	2.15936	2.19662	2.17668	1.78729	1.37394	2.08219
- Risk Level 2		2.13450	2.14500	2.18174	2.16208	1.77743	1.36810	2.06882
- Risk Level 3		2.10659	2.11681	2.15259	2.13744	1.75803	1.35658	2.04259

TABLE G.8
AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS

A/C: DHC-6
Temp: 22 C
Elev: 1000 ft
GTOW: 12500 lbs
(non-instrument runway) STOL

a)

CIVIL WORKS		PAVEMENT TYPE (P)						
		Gravel	Aggregate-turf	Fortland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.		$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)		$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)		$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)		$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)		$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)		$262,545.98	$258,046.88	$267,340.51	$271,501.37	$357,421.71	$539,876.84	$292,305.67
Subtotals		$416,183.48	$408,021.88	$435,628.01	$447,113.87	$675,871.71	$1,187,951.84	$504,543.17
(strip length = 456 m.)								
(graded area width = 38 m.)								
(runway pavement width = 15.2 m. max to 7.6 m. min)								
(runway pavement length = 396 m.);gravel=		403 ;	turf=	411				
Civil works Subtotals:	1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
	3+4+5 :	$284,733.48	$279,371.88	$292,978.01	$298,863.87	$418,421.71	$678,501.84	$328,293.17

b) AIR TERMINAL BUILDING AND RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,800.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,500.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachments	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$17,398.00
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$81,998.00

Grand Totals	$693,181.48	$690,019.88	$717,626.01	$725,111.27	$757,869.71	$1,469,949.84	$786,541.17

		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing		(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
	Constant $	$8,433.40	$8,545.08	$12,482.58	$12,482.58	$8,433.40	$0.00	$12,482.58
	PV	$3,251.41	$3,294.47	$1,752.50	$1,752.50	$3,251.41	$0.00	$1,752.50
f) O & M	Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
	PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Emerg. Serv. DOC	Annual	$139.61	$189.81	$187.00	$127.00	$189.81	$187.00	$187.00
	PV	$1,615.92	$1,615.92	$1,592.04	$1,592.04	$1,615.92	$1,592.04	$1,592.04
h) Incremental Reg. Pass. Serv. DOC	Annual	$3,731.14	$3,731.14	$3,676.00	$3,676.00	$3,731.14	$3,676.00	$3,676.00
(60% LF)	PV	$31,765.43	$31,765.43	$31,295.99	$31,295.99	$31,765.43	$31,295.99	$31,295.99
i) Incremental A/C Accident Costs								
Risk Level 0	Annual	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00
	PV	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96
Risk Level 1	Annual	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00
(1.5X)	PV	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88
Risk Level 2	Annual	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00
(2X)	PV	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80
Risk Level 3	Annual	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00
(3X)	PV	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 400)								
a) Emergency Health Care								
-lives saved (0.74/yr)	Annual	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00
	PV	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41
-permanent disabilities	Annual	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00
prevented (1.48/yr)	PV	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39
-temp disability-lost	Annual	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00
work days saved (23.3/yr)	PV	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41
b) Air Service User Time	Annual	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00
Savings (5,024 hrs/yr)	PV	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69

c) Employment (person-yrs)

-long term (annual)	-local	1.8							
	-rest of Manitoba	0							
	-rest of Canada	0							
	-total	1.8							
-short term direct:									
civil works	-local		2.20	2.16	2.30	2.36	3.57	2.98	2.66
	-rest of Manitoba		2.20	2.16	2.30	2.36	3.57	2.98	2.66
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		4.40	4.32	4.59	4.71	7.13	5.96	5.32
ATB	-local		0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba		0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local		0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba		0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local		0.38	0.39	0.38	0.38	0.39	0.38	0.38
	-rest of Manitoba		1.64	1.65	1.62	1.62	1.65	1.62	1.62
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		2.02	2.03	2.00	2.00	2.03	2.00	2.00
SUBTOTAL	-local		3.20	3.16	3.29	3.35	4.56	3.97	3.65
	-rest of Manitoba		4.60	4.57	4.68	4.74	5.97	5.36	5.04
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		7.79	7.72	7.96	8.08	10.53	9.33	8.69

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.89	1.85	1.98	2.03	3.08	2.58	2.30
	-rest of Canada	1.98	1.94	2.07	2.13	3.22	2.70	2.40
	-total	3.87	3.80	4.06	4.16	6.29	5.29	4.70
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.04	0.04	0.03	0.03	0.04	0.03	0.03
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.05	0.05	0.05	0.05	0.05	0.05	0.05
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.31	2.28	2.40	2.45	3.49	3.00	2.71
	-rest of Canada	2.13	2.09	2.22	2.28	3.37	2.85	2.55
	-total	4.44	4.37	4.62	4.73	6.86	5.85	5.26
TOTAL SHORT TERM	-local	3.20	3.16	3.29	3.35	4.56	3.97	3.65
	-rest of Manitoba	6.91	6.84	7.08	7.18	9.47	8.36	7.75
	-rest of Canada	2.13	2.09	2.22	2.28	3.37	2.85	2.55
	-total	12.23	12.09	12.59	12.81	17.39	15.19	13.95
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,229,353.04	$1,221,234.50	$1,204,237.34	$1,215,723.20	$1,489,041.28	$1,954,808.67	$1,273,152.50
- Risk Level 1		$1,237,125.96	$1,229,007.42	$1,212,010.26	$1,223,496.12	$1,496,814.19	$1,962,581.59	$1,280,925.42
- Risk Level 2		$1,244,898.37	$1,236,780.33	$1,219,783.18	$1,231,269.04	$1,504,587.11	$1,970,354.51	$1,288,698.34
- Risk Level 3		$1,260,444.71	$1,252,326.17	$1,235,329.01	$1,246,814.87	$1,520,132.94	$1,985,900.34	$1,304,244.17
TOTAL PV INCREMENTAL BENEFITS		$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90
PVB/PVC (INCREMENTAL)								
- Risk Level 0		2.03705	2.05059	2.07953	2.05988	1.68179	1.28107	1.96697
- Risk Level 1		2.02425	2.03762	2.06620	2.04680	1.67305	1.27600	1.95503
- Risk Level 2		2.01161	2.02481	2.05303	2.03388	1.66441	1.27095	1.94324
- Risk Level 3		1.98680	1.99968	2.02719	2.00852	1.64739	1.26101	1.92003

TABLE G.9
AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS

A/C: DHC-6
Temp: 15 C
Elev: 0 ft
GTOW: 10000 lbs
STOL

(non-instrument runway)

a)

CIVIL WORKS	Gravel	Aggregate-turf	PAVEMENT TYPE (P) Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)	$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)	$183,403.77	$181,733.11	$187,392.74	$190,326.76	$250,089.01	$379,572.36	$204,996.98
Subtotals	$337,041.27	$331,708.11	$355,680.24	$365,939.28	$568,539.01	$1,027,647.36	$417,234.43
(strip length = 295 m.)							
(graded area width = 38 m.)							
(runway pavement width = 15.2 m. max to 7.6 m. min)							
(runway pavement length = 235 m.);gravel=	239	turf=	243				
Civil works Subtotals: 1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
3+4+5 :	$205,591.27	$203,058.11	$213,030.24	$217,689.28	$311,089.01	$518,197.36	$240,984.48

b) AIR TERMINAL BUILDING AND RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,800.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachments	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$13,292.50
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$77,892.50

Grand Totals	$614,933.77	$609,660.61	$633,572.74	$643,831.75	$846,431.51	$1,305,537.86	$695,126.98

		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing		(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
	Constant $	$5,927.58	$5,987.07	$8,802.12	$8,802.12	$5,927.58	$0.00	$8,802.12
	PV	$2,285.32	$2,308.26	$1,235.78	$1,235.78	$2,285.32	$0.00	$1,235.78
f) O $ M	Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
	PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Emerg. Serv. DOC	Annual	$189.81	$189.81	$187.00	$187.00	$189.81	$187.00	$187.00
	PV	$1,615.92	$1,615.92	$1,592.04	$1,592.04	$1,615.92	$1,592.04	$1,592.04
h) Incremental Reg. Pass. Serv. DOC (60% LF)	Annual	$3,731.14	$3,731.14	$3,676.00	$3,676.00	$3,731.14	$3,676.00	$3,676.00
	PV	$31,765.43	$31,765.43	$31,295.99	$31,295.99	$31,765.43	$31,295.99	$31,295.99
i) Incremental A/C Accident Costs								
Risk Level 0	Annual	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00
	PV	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96
Risk Level 1 (1.5X)	Annual	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00
	PV	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88
Risk Level 2 (2X)	Annual	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00
	PV	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80
Risk Level 3 (3X)	Annual	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00
	PV	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 400)								
a) Emergency Health Care								
-lives saved (0.74/yr)	Annual	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00
	PV	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41
-permanent disabilities	Annual	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00
prevented (1.48/yr)	PV	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39
-temp disability-lost	Annual	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00
work days saved (23.3/yr)	PV	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41
b) Air Service User Time	Annual	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00
Savings (5,024 hrs/yr)	PV	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69

c) Employment (person-yrs)

-long term (annual)	-local	1.8							
	-rest of Manitoba	0							
	-rest of Canada	0							
	-total	1.8							
-short term direct:									
civil works	-local		1.78	1.75	1.87	1.93	3.00	2.55	2.20
	-rest of Manitoba		1.78	1.75	1.87	1.93	3.00	2.55	2.20
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		3.56	3.51	3.75	3.86	5.99	5.11	4.39
ATB	-local		0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba		0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local		0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba		0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local		0.36	0.36	0.36	0.36	0.36	0.36	0.36
	-rest of Manitoba		1.51	1.51	1.50	1.50	1.51	1.50	1.50
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.86	1.87	1.85	1.85	1.87	1.85	1.85
SUBTOTAL	-local		2.75	2.72	2.84	2.89	3.97	3.52	3.16
	-rest of Manitoba		4.04	4.02	4.13	4.18	5.27	4.81	4.45
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		6.79	6.75	6.97	7.08	9.23	8.33	7.62

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.53	1.51	1.62	1.67	2.59	2.21	1.90
	-rest of Canada	1.60	1.58	1.69	1.74	2.71	2.32	1.99
	-total	3.14	3.09	3.31	3.41	5.29	4.53	3.88
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.04	0.04	0.04	0.04	0.04	0.04	0.04
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.94	1.92	2.03	2.08	3.00	2.62	2.31
	-rest of Canada	1.75	1.72	1.84	1.89	2.85	2.46	2.13
	-total	3.69	3.64	3.87	3.96	5.85	5.08	4.44
TOTAL SHORT TERM	-local	2.75	2.72	2.84	2.89	3.97	3.52	3.16
	-rest of Manitoba	5.99	5.94	6.16	6.26	8.26	7.43	6.76
	-rest of Canada	1.75	1.72	1.84	1.89	2.85	2.46	2.13
	-total	10.49	10.39	10.84	11.04	15.08	13.41	12.06
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,145,139.24	$1,139,829.01	$1,119,667.35	$1,129,926.39	$1,376,636.98	$1,790,398.69	$1,131,221.59
- Risk Level 1		$1,152,912.16	$1,147,601.93	$1,127,440.27	$1,137,699.31	$1,384,409.90	$1,798,171.61	$1,138,994.51
- Risk Level 2		$1,160,685.06	$1,155,374.85	$1,135,213.19	$1,145,472.23	$1,392,182.82	$1,805,944.53	$1,196,767.43
- Risk Level 3		$1,176,230.91	$1,170,920.68	$1,150,759.02	$1,161,018.06	$1,407,728.65	$1,821,490.36	$1,212,313.26
TOTAL PV INCREMENTAL BENEFITS		$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90
PVB/PVC (INCREMENTAL)								
- Risk Level 0		2.18685	2.19704	2.23660	2.21629	1.81911	1.39871	2.12005
- Risk Level 1		2.17211	2.18216	2.22119	2.20115	1.80989	1.39266	2.10619
- Risk Level 2		2.15756	2.16748	2.20597	2.18622	1.79879	1.38667	2.09251
- Risk Level 3		2.12905	2.13870	2.17617	2.15694	1.77593	1.37484	2.06558

TABLE G.10
AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS

(non-instrument runway)

A/C: DHC-6
Temp: 15 C
Elev: 0 ft
GTOW: 12500 lbs
STOL

a)

CIVIL WORKS		PAVEMENT TYPE (P)					
	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)	$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)	$247,859.64	$243,941.51	$252,443.41	$256,375.67	$337,504.09	$510,006.44	$276,036.97
Subtotals	$401,497.14	$393,916.51	$420,730.91	$431,988.17	$655,954.09	$1,158,081.44	$488,274.47

(strip length = 426 m.)
(graded area width = 38 m.)
(runway pavement width = 15.2 m. max to 7.6 m. min)
(runway pavement length = 366 m.);gravel= 373 ; turf= 380

Civil works Subtotals:		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
	1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
	3+4+5 :	$270,047.14	$265,266.51	$278,080.91	$283,738.17	$398,504.09	$648,631.44	$312,024.47

b) AIR TERMINAL BUILDING AND RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,800.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachments	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$16,633.00
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$81,233.00

Grand Totals	$682,730.14	$675,149.51	$701,963.91	$713,221.17	$937,137.09	$1,439,314.44	$769,507.47

		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing		(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
	Constant $	$7,968.40	$8,072.27	$11,796.78	$11,796.78	$7,968.40	$0.00	$11,796.78
	PV	$3,072.14	$3,112.18	$1,656.22	$1,656.22	$3,072.14	$0.00	$1,656.22
f) O $ M	Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
	PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Emerg. Serv. DOC	Annual	$189.81	$189.81	$187.00	$187.00	$189.81	$187.00	$187.00
	PV	$1,615.92	$1,615.92	$1,592.04	$1,592.04	$1,615.92	$1,592.04	$1,592.04
h) Incremental Reg. Pass. Serv. DOC (60% LF)	Annual	$3,731.14	$3,731.14	$3,676.00	$3,676.00	$3,731.14	$3,676.00	$3,676.00
	PV	$31,765.43	$31,765.43	$31,295.99	$31,295.99	$31,765.43	$31,295.99	$31,295.99
i) Incremental A/C Accident Costs								
Risk Level 0	Annual	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00
	PV	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96
Risk Level 1 (1.5X)	Annual	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00
	PV	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88
Risk Level 2 (2X)	Annual	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00
	PV	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80
Risk Level 3 (3X)	Annual	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00
	PV	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 400)								
a) Emergency Health Care								
-lives saved (0.74/yr)	Annual	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00
	PV	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41
-permanent disabilities	Annual	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00
prevented (1.48/yr)	PV	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39
-temp disability-lost	Annual	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00
work days saved (23.3/yr)	PV	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41
b) Air Service User Time	Annual	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00
Savings (5,024 hrs/yr)	PV	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69

c) Employment (person-yrs)

-long term (annual)	-local	1.8						
	-rest of Manitoba	0						
	-rest of Canada	0						
	-total	1.8						
-short term direct:								
civil works	-local		2.12	2.08	2.22	2.28	3.46	2.90	2.57
	-rest of Manitoba		2.12	2.09	2.22	2.28	3.46	2.90	2.57
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		4.25	4.17	4.44	4.55	6.92	5.80	5.14
ATB	-local		0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba		0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local		0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba		0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local		0.38	0.38	0.38	0.38	0.38	0.38	0.38
	-rest of Manitoba		1.61	1.62	1.60	1.60	1.62	1.60	1.60
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.99	2.00	1.98	1.98	2.00	1.98	1.98
SUBTOTAL	-local		3.11	3.08	3.20	3.26	4.45	3.89	3.56
	-rest of Manitoba		4.49	4.47	4.57	4.63	5.84	5.26	4.93
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		7.61	7.54	7.78	7.90	10.29	9.14	8.49

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.83	1.79	1.91	1.97	2.98	2.51	2.22
	-rest of Canada	1.91	1.88	2.00	2.06	3.12	2.63	2.32
	-total	3.74	3.67	3.92	4.02	6.11	5.14	4.55
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.05	0.05	0.05	0.05	0.05	0.05	0.05
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.24	2.21	2.33	2.38	3.40	2.93	2.64
	-rest of Canada	2.06	2.02	2.15	2.20	3.27	2.78	2.47
	-total	4.30	4.23	4.48	4.59	6.67	5.71	5.11
TOTAL SHORT TERM	-local	3.11	3.08	3.20	3.26	4.45	3.89	3.56
	-rest of Manitoba	6.74	6.68	6.91	7.02	9.24	8.19	7.57
	-rest of Canada	2.06	2.02	2.15	2.20	3.27	2.78	2.47
	-total	11.91	11.79	12.26	12.48	16.96	14.85	13.60
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,213,722.41	$1,206,181.84	$1,188,478.76	$1,199,736.22	$1,468,179.38	$1,924,173.27	$1,256,022.52
- Risk Level 1		$1,221,495.34	$1,213,954.76	$1,196,251.88	$1,207,509.14	$1,475,952.29	$1,931,946.19	$1,263,795.44
- Risk Level 2		$1,229,268.25	$1,221,727.67	$1,204,024.79	$1,215,282.05	$1,483,725.21	$1,939,71[illegible].11	$1,271,568.[illegible]5
- Risk Level 3		$1,244,814.09	$1,237,273.51	$1,219,570.53	$1,230,827.[illegible]	$1,499,271.04	$1,955,[illegible]54.94	$1,287,1[illegible]4.19
TOTAL PV INCREMENTAL BENEFITS		$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90
PVB/PVC (INCREMENTAL)								
- Risk Level 0		2.06328	2.07618	2.10710	2.08733	1.70568	1.30147	1.99379
- Risk Level 1		2.05015	2.06289	2.09341	2.07390	1.69670	1.29623	1.98153
- Risk Level 2		2.03719	2.04976	2.07990	2.06063	1.68781	1.29104	1.96942
- Risk Level 3		2.01175	2.02401	2.05339	2.03461	1.67031	1.28077	1.945[illegible]

TABLE G.11
AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS

A/C: DHC-6
Temp: -18 C
Elev: 1000 ft
GTOW: 10000 lbs
STOL

(non-instrument runway)

a)

CIVIL WORKS			PAVEMENT TYPE (P)				
	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)	$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)	$172,722.10	$171,556.00	$176,468.20	$179,234.60	$235,602.52	$357,667.40	$193,066.60
Subtotals	$326,359.60	$321,531.00	$344,755.70	$354,847.10	$554,052.52	$1,005,742.40	$405,304.10

(strip length = 273 m.)
(graded area width = 38 m.)
(runway pavement width = 15.2 m. max to 7.6 m. min)
(runway pavement length = 213 m.);gravel= 217 ; turf= 220

Civil works Subtotals:		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
	1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
	3+4+5 :	$194,909.60	$192,881.00	$202,105.70	$206,597.10	$296,602.52	$496,292.40	$229,054.10

b) AIR TERMINAL BUILDING AND RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,800.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachments	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$12,731.50
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$77,331.50

Grand Totals	$603,691.10	$598,862.50	$622,087.20	$632,176.60	$831,384.02	$1,283,073.90	$682,635.60

		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing		(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
	Constant $	$5,589.37	$5,645.94	$8,299.20	$8,299.20	$5,589.37	$0.00	$8,299.20
	PV	$2,154.93	$2,176.74	$1,165.17	$1,165.17	$2,154.93	$0.00	$1,165.17
f) O $ M	Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
	PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Emerg. Serv. DOC	Annual	$189.81	$189.81	$187.00	$187.00	$189.81	$187.00	$187.00
	PV	$1,615.92	$1,615.92	$1,592.04	$1,592.04	$1,615.92	$1,592.04	$1,592.04
h) Incremental Reg. Pass. Serv. DOC (60% LF)	Annual	$3,731.14	$3,731.14	$3,676.00	$3,676.00	$3,731.14	$3,676.00	$3,676.00
	PV	$31,765.43	$31,765.43	$31,295.99	$31,295.99	$31,765.43	$31,295.99	$31,295.99
i) Incremental A/C Accident Costs								
Risk Level 0	Annual	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00
	PV	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96
Risk Level 1 (1.5X)	Annual	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00
	PV	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88
Risk Level 2 (2X)	Annual	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00
	PV	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80
Risk Level 3 (3X)	Annual	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00
	PV	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 400)								
a) Emergency Health Care								
-lives saved (0.74/yr)	Annual	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00
	PV	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41
-permanent disabilities	Annual	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00
prevented (1.48/yr)	PV	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39
-temp disability-lost	Annual	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00
work days saved (23.3/yr)	PV	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41
b) Air Service User Time	Annual	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00
Savings (5,024 hrs/yr)	PV	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69

c) Employment (person-yrs)

-long term (annual)	-local	1.8							
	-rest of Manitoba	0							
	-rest of Canada	0							
	-total	1.8							
-short term direct:									
civil works	-local		1.72	1.70	1.82	1.87	2.92	2.50	2.13
	-rest of Manitoba		1.72	1.70	1.82	1.87	2.92	2.50	2.13
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		3.45	3.40	3.63	3.74	5.84	4.99	4.27
ATB	-local		0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba		0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local		0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba		0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local		0.35	0.36	0.35	0.35	0.36	0.35	0.35
	-rest of Manitoba		1.49	1.49	1.48	1.48	1.49	1.48	1.48
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.84	1.85	1.83	1.83	1.85	1.83	1.83
SUBTOTAL	-local		2.69	2.66	2.78	2.83	3.89	3.46	3.10
	-rest of Manitoba		3.97	3.95	4.06	4.11	5.17	4.73	4.37
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		6.66	6.62	6.83	6.94	9.06	8.19	7.47

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.48	1.46	1.57	1.61	2.52	2.16	1.84
	-rest of Canada	1.55	1.53	1.64	1.69	2.64	2.26	1.93
	-total	3.04	2.99	3.21	3.30	5.16	4.42	3.77
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.04	0.04	0.04	0.04	0.04	0.04	0.04
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.89	1.87	1.98	2.02	2.93	2.57	2.26
	-rest of Canada	1.70	1.67	1.79	1.83	2.78	2.41	2.07
	-total	3.59	3.55	3.76	3.86	5.71	4.98	4.33
TOTAL SHORT TERM	-local	2.69	2.66	2.78	2.93	3.89	3.46	3.10
	-rest of Manitoba	5.87	5.83	6.03	6.13	8.10	7.31	6.63
	-rest of Canada	1.70	1.67	1.79	1.83	2.78	2.41	2.07
	-total	10.25	10.16	10.60	10.89	14.77	13.17	11.80
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,133,766.18	$1,128,959.73	$1,108,111.20	$1,118,202.60	$1,361,459.10	$1,767,932.73	$1,168,657.60
- Risk Level 1		$1,141,579.09	$1,136,732.20	$1,115,664.12	$1,125,975.52	$1,369,232.01	$1,775,705.65	$1,176,432.52
- Risk Level 2		$1,149,312.01	$1,144,505.22	$1,123,657.04	$1,133,748.44	$1,377,004.97	$1,783,478.57	$1,184,205.44
- Risk Level 3		$1,164,857.84	$1,160,051.65	$1,139,202.57	$1,149,294.27	$1,392,550.76	$1,799,024.40	$1,199,751.27
TOTAL PV INCREMENTAL BENEFITS		$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90
PVB/PVC (INCREMENTAL)								
- Risk Level 0		2.20879	2.21819	2.25993	2.23953	1.83939	1.41648	2.14284
- Risk Level 1		2.19367	2.20303	2.24418	2.22407	1.82894	1.41028	2.12868
- Risk Level 2		2.17891	2.18806	2.22866	2.20882	1.81862	1.40414	2.11471
- Risk Level 3		2.14983	2.15874	2.19825	2.17895	1.79832	1.39200	2.08731

TABLE 6.12
AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS

A/C: DHC-6
Temp: -18 C
Elev: 1000 ft
GTOW: 12500 lbs
STOL

(non-instrument runway)

a)

CIVIL WORKS		PAVEMENT TYPE (P)						
		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.		$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)		$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)		$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,930.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)		$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)		$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)		$228,144.36	$224,882.16	$232,580.61	$236,208.07	$310,766.22	$470,179.24	$254,345.37
Subtotals		$381,781.86	$374,857.16	$400,868.11	$411,820.57	$629,216.22	$1,118,254.24	$466,582.87
(strip length = 386 m.)								
(graded area width = 38 m.)								
(runway pavement width = 15.2 m. max to 7.6 m. min)								
(runway pavement length = 326 m.);gravel=		332 ;	turf=	338				
Civil works Subtotals:	1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
	3+4+5 :	$250,331.86	$246,207.16	$258,218.11	$263,570.57	$371,766.22	$608,804.24	$290,332.87

b) AIR TERMINAL BUILDING AND
RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,600.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,800.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachments	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$15,613.00
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$80,213.00

Grand Totals	$661,994.86	$655,070.16	$661,081.11	$692,033.57	$909,429.22	$1,398,467.24	$746,793.87

			Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing			(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
		Constant $	$7,344.17	$7,433.41	$10,882.38	$10,882.38	$7,344.17	$0.00	$10,882.38
		PV	$2,831.47	$2,865.58	$1,527.84	$1,527.84	$2,831.47	$0.00	$1,527.84
f) O $ M		Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
		PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Emerg. Serv. DOC		Annual	$189.81	$189.81	$187.00	$187.00	$189.81	$187.00	$187.00
		PV	$1,615.92	$1,615.92	$1 592.04	$1,592.04	$1,615.92	$1,592.04	$1,592.04
h) Incremental Reg. Pass. Serv. DOC (60% LF)		Annual	$3,731.14	$3,731.14	$3,676.00	$3,676.00	$3,731.14	$3,676.00	$3,676.00
		PV	$31,765.43	$31,765.43	$31,295.99	$31,295.99	$31,765.43	$31,295.99	$31,295.99
i) Incremental A/C Accident Costs	Risk Level 0	Annual	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00
		PV	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96
	Risk Level 1 (1.5X)	Annual	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00
		PV	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88
	Risk Level 2 (2X)	Annual	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00
		PV	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80
	Risk Level 3 (3X)	Annual	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00
		PV	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63

j) Mobile Equipment Replacement								
-pickup truck (5 yrs.)	Constant $ PV	$15,000.00 $18,810.33	$15,000.00 $18,810.33	$15,000.00 $18,810.33	$15,000.00 $18,810.33	$15,000.00 $18,810.33	$15,000.00 $18,810.33	$15,000.00 $18,810.33
-5 ton truck (10 yrs.)	Constant $ PV	$40,000.00 $15,421.60	$40,000.00 $15,421.60	$40,000.00 $15,421.60	$40,000.00 $15,421.60	$40,000.00 $15,421.60	$40,000.00 $15,421.60	$40,000.00 $15,421.60
-tractor-loader (10 yrs.)	Constant $ PV	$60,000.00 $23,132.40	$60,000.00 $23,132.40	$60,000.00 $23,132.40	$60,000.00 $23,132.40	$60,000.00 $23,132.40	$60,000.00 $23,132.40	$60,000.00 $23,132.40
-attachments (10 yrs.)	Constant $ PV	$25,000.00 $9,638.50	$25,000.00 $9,638.50	$25,000.00 $9,638.50	$25,000.00 $9,638.50	$25,000.00 $9,638.50	$25,000.00 $9,638.50	$25,000.00 $9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 400)								
a) Emergency Health Care								
-lives saved (0.74/yr)	Annual PV	$175,949.00 $1,497,959.41	$175,949.00 $1,497,959.41	$175,949.00 $1,497,959.41	$175,949.00 $1,497,959.41	$175,949.00 $1,497,959.41	$175,949.00 $1,497,959.41	$175,949.00 $1,497,959.41
-permanent disabilities prevented (1.48/yr)	Annual PV	$68,301.00 $581,487.39	$68,301.00 $581,487.39	$68,301.00 $581,487.39	$68,301.00 $581,487.39	$68,301.00 $581,487.39	$68,301.00 $581,487.39	$68,301.00 $581,487.39
-temp disability-lost work days saved (23.3/yr)	Annual PV	$324.00 $2,758.41	$324.00 $2,758.41	$324.00 $2,758.41	$324.00 $2,758.41	$324.00 $2,758.41	$324.00 $2,758.41	$324.00 $2,758.41
b) Air Service User Time Savings (5,024 hrs/yr)	Annual PV	$49,573.00 $422,044.69	$49,573.00 $422,044.69	$49,573.00 $422,044.69	$49,573.00 $422,044.69	$49,573.00 $422,044.69	$49,573.00 $422,044.69	$49,573.00 $422,044.69

c) Employment (person-yrs)

-long term (annual)	-local	1.8							
	-rest of Manitoba	0							
	-rest of Canada	0							
	-total	1.8							
-short term direct:									
civil works	-local		2.02	1.98	2.11	2.17	3.32	2.79	2.46
	-rest of Manitoba		2.02	1.98	2.11	2.17	3.32	2.79	2.46
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		4.04	3.97	4.23	4.34	6.64	5.59	4.92
ATB	-local		0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba		0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local		0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba		0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local		0.37	0.37	0.37	0.37	0.37	0.37	0.37
	-rest of Manitoba		1.58	1.59	1.57	1.57	1.59	1.57	1.57
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.95	1.96	1.94	1.94	1.96	1.94	1.94
SUBTOTAL	-local		3.00	2.97	3.09	3.15	4.30	3.77	3.44
	-rest of Manitoba		4.36	4.33	4.44	4.50	5.67	5.12	4.76
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		7.36	7.30	7.53	7.65	9.97	8.90	8.22

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.74	1.71	1.82	1.87	2.86	2.42	2.12
	-rest of Canada	1.82	1.78	1.91	1.96	3.00	2.53	2.22
	-total	3.55	3.49	3.73	3.83	5.86	4.96	4.34
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.04	0.04	0.04	0.04	0.04	0.04	0.04
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.15	2.12	2.24	2.29	3.23	2.84	2.54
	-rest of Canada	1.96	1.93	2.05	2.11	3.14	2.68	2.37
	-total	4.12	4.05	4.29	4.40	6.42	5.52	4.91
TOTAL SHORT TERM	-local	3.00	2.97	3.09	3.15	4.30	3.77	3.44
	-rest of Manitoba	6.51	6.45	6.68	6.79	8.94	7.56	7.32
	-rest of Canada	1.96	1.93	2.05	2.11	3.14	2.68	2.37
	-total	11.47	11.35	11.82	12.04	16.39	14.41	13.13
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,192,746.43	$1,185,856.19	$1,167,467.73	$1,178,420.24	$1,440,180.84	$1,883,326.07	$1,233,182.54
- Risk Level 1		$1,200,519.40	$1,193,629.10	$1,175,240.70	$1,186,193.16	$1,447,953.76	$1,891,098.99	$1,240,955.46
- Risk Level 2		$1,208,292.31	$1,201,402.02	$1,183,013.62	$1,193,966.[illegible]	$1,455,726.67	$1,898,871.91	$1,248,728.38
- Risk Level 3		$1,223,833.15	$1,216,947.85	$1,198,559.45	$1,209,511.91	$1,471,272.51	$1,914,417.74	$1,264,274.21
TOTAL PV INCREMENTAL BENEFITS		$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90
PVB/PVC (INCREMENTAL)								
- Risk Level 0		2.09957	2.11177	2.14503	2.12509	1.73884	1.33[illegible]	2.03072
- Risk Level 1		[illegible]	2.09801	2.13084	2.11117	1.72951	1.32423	2.01800
- Risk Level 2		[illegible]	2.08444	2.11684	[illegible]	1.72027	1.31881	2.00544
- Risk Level 3		[illegible]	[illegible]	[illegible]	[illegible]	1.71110	1.31310	[illegible]

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TABLE G.13
AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS

A/C: DHC-6
Temp: 22 C
Elev: 1000 ft
GTOW: 10000 lbs
(non-instrument runway) CAR-3

a)

CIVIL WORKS		PAVEMENT TYPE (P)					
	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)	$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)	$214,093.37	$211,522.43	$218,180.08	$221,586.56	$291,710.27	$441,304.52	$238,618.96
Subtotals	$367,730.87	$361,497.43	$386,467.58	$397,199.06	$610,160.27	$1,089,379.52	$450,856.46

(strip length = 357 m.)
(graded area width = 38 m.)
(runway pavement width = 15.2 m. max to 7.6 m. min)
(runway pavement length = 297 m.);gravel= 303 ; turf= 308

Civil works Subtotals:		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
	1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
	3+4+5 :	$236,280.87	$232,847.43	$243,817.56	$248,949.06	$352,710.27	$579,929.52	$274,606.46

b) AIR TERMINAL BUILDING AND
RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,800.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachments	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$14,873.50
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$79,473.50

Grand Totals	$647,204.37	$640,970.93	$665,941.08	$676,672.56	$889,633.77	$1,368,853.02	$730,329.96

		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing		(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
	Constant $	$6,899.28	$6,985.60	$10,219.44	$10,219.44	$6,899.28	$0.00	$10,219.44
	PV	$2,659.95	$2,693.23	$1,434.77	$1,434.77	$2,659.95	$0.00	$1,434.77
f) O $ M	Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
	PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Emerg. Serv. DOC	Annual	$189.81	$189.81	$187.00	$187.00	$189.81	$187.00	$187.00
	PV	$1,615.92	$1,615.92	$1,592.04	$1,592.04	$1,615.92	$1,592.04	$1,592.04
h) Incremental Reg. Pass. Serv. DOC (60% LF)	Annual	$3,731.14	$3,731.14	$3,676.00	$3,676.00	$3,731.14	$3,676.00	$3,676.00
	PV	$31,765.43	$31,765.43	$31,295.99	$31,295.97	$31,765.43	$31,295.97	$31,295.97
i) Incremental A/C Accident Costs Risk Level 0	Annual	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00
	PV	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96
Risk Level 1 (1.5X)	Annual	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00
	PV	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88
Risk Level 2 (2X)	Annual	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00
	PV	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80
Risk Level 3 (3X)	Annual	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00
	PV	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 400)								
a) Emergency Health Care								
-lives saved (0.74/yr)	Annual	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00
	PV	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41
-permanent disabilities	Annual	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00
prevented (1.48/yr)	PV	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39
-temp disability-lost	Annual	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00
work days saved (23.3/yr)	PV	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41
b) Air Service User Time	Annual	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00
Savings (5,024 hrs/yr)	PV	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69

c) Employment (person-yrs)

-long term (annual)	-local	1.8							
	-rest of Manitoba	0							
	-rest of Canada	0							
	-total	1.8							
-short term direct:									
civil works	-local		1.94	1.91	2.04	2.09	3.22	2.72	2.37
	-rest of Manitoba		1.94	1.91	2.04	2.09	3.22	2.72	2.37
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		3.89	3.82	4.07	4.19	6.43	5.44	4.75
ATB	-local		0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba		0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local		0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba		0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local		0.37	0.37	0.37	0.37	0.37	0.37	0.37
	-rest of Manitoba		1.56	1.57	1.55	1.55	1.57	1.55	1.55
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.92	1.94	1.91	1.91	1.94	1.91	1.91
SUBTOTAL	-local		2.92	2.89	3.01	3.07	4.20	3.69	3.35
	-rest of Manitoba		4.26	4.24	4.34	4.40	5.54	5.02	4.68
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		7.18	7.13	7.35	7.47	9.74	8.72	8.03

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.67	1.64	1.76	1.81	2.78	2.36	2.05
	-rest of Canada	1.75	1.72	1.84	1.89	2.90	2.46	2.15
	-total	3.42	3.37	3.60	3.70	5.68	4.82	4.20
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.04	0.04	0.04	0.04	0.04	0.04	0.04
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.09	2.06	2.17	2.22	3.19	2.77	2.46
	-rest of Canada	1.90	1.87	1.99	2.04	3.05	2.61	2.29
	-total	3.98	3.93	4.16	4.26	6.24	5.38	4.75
TOTAL SHORT TERM	-local	2.92	2.89	3.01	3.07	4.20	3.69	3.35
	-rest of Manitoba	6.35	6.30	6.51	6.62	8.73	7.77	7.14
	-rest of Canada	1.90	1.87	1.99	2.04	3.05	2.61	2.29
	-total	11.16	11.05	11.51	11.72	15.98	14.09	12.74
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,177,764.47	$1,171,584.31	$1,152,234.18	$1,162,966.15	$1,420,213.87	$1,553,711.85	$1,216,623.56
- Risk Level 1		$1,185,557.39	$1,179,337.23	$1,160,007.59	$1,170,7[illegible]	$1,427,986.78	$1,561,484.77	$1,224,396.47
- Risk Level 2		$1,1[illegible],330.21	$1,187,130.14	$1,167,780.51	$1,178,[illegible]	$1,435,759.70	$1,569,257.69	$1,232,169.39
- Risk Level 3		$1,208,276.14	$1,202,675.98	$1,183,326.04	$1,194,[illegible]57.82	$1,451,305.53	$1,584,803.52	$1,247,715.22
TOTAL PV INCREMENTAL BENEFITS		$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90
B/C RATIO (INCREMENTAL)								
- Risk Level 0		2.12624	2.13749	2.17331	[illegible]	1.76329	1.35094	2.05836
- Risk Level 1		2.11230	2.12340	2.15882	[illegible]	1.75369	1.34130	2.04527
- Risk Level 2		[illegible]	[illegible]	2.14440	[illegible]	1.74410	[illegible]	2.03209
- Risk Level 3		2.07152	2.08227	2.11[illegible]	[illegible]	1.72552	1.32362	2.00797

TABLE G.14
AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS

A/C: DHC-6
Temp: 22 C
Elev: 1000 ft
GTOW: 12500 lbs
CAR-3

(non-instrument runway)

a)

CIVIL WORKS		PAVEMENT TYPE (P)						
		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.		$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)		$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)		$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)		$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)		$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)		$306,077.46	$299,821.04	$311,535.24	$316,374.26	$416,459.14	$628,492.36	$340,569.48
	Subtotals	$459,714.96	$449,796.04	$479,822.74	$491,986.78	$734,909.14	$1,276,567.36	$552,806.98
(strip length = 545 m.)								
(graded area width = 38 m.)								
(runway pavement width = 15.2 m. max to 7.6 m. min)								
(runway pavement lengtn = 485 m.);gravel=		494 ;	turf=	503				
Civil works Subtotals:	1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
	3+4+5 :	$328,264.96	$321,146.04	$337,172.74	$343,736.78	$477,459.14	$767,117.36	$376,556.98

b) AIR TERMINAL BUILDING AND
RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,300.00
Sewage Disposal	$1,500.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachments	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$19,667.50
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$84,267.50

Grand Totals	$743,992.46	$734,063.54	$764,090.24	$776,254.28	$1,019,176.64	$1,560,834.86	$837,074.48

			Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing			(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
		Constant $	$9,811.70	$9,945.33	$14,517.12	$14,517.12	$9,811.70	$0.00	$14,517.12
		PV	$3,782.80	$3,834.32	$2,038.14	$2,038.14	$3,782.80	$0.00	$2,038.14
f) O & M		Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
		PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Emerg. Serv. DOC		Annual	$189.81	$189.81	$187.00	$187.00	$189.81	$187.00	$187.00
		PV	$1,615.92	$1,615.92	$1,592.04	$1,592.04	$1,615.92	$1,592.04	$1,592.04
h) Incremental Reg. Pass. Serv. DOC (60% LF)		Annual	$3,731.14	$3,731.14	$3,676.00	$3,676.00	$3,731.14	$3,676.00	$3,676.00
		PV	$31,765.43	$31,765.43	$31,295.99	$31,295.99	$31,765.43	$31,295.99	$31,295.99
i) Incremental A/C Accident Costs	Risk Level 0	Annual	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00
		PV	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.76	$44,423.96
	Risk Level 1 (1.5X)	Annual	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00
		PV	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.82	$52,196.88	$52,196.88
	Risk Level 2 (2X)	Annual	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00
		PV	$59,969.20	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80
	Risk Level 3 (3X)	Annual	$8,870.00	$8,870.00	$8,870.00	$8,[illegible]	$8,870.00	$8,870.00	$8,870.00
		PV	$75,515.63	$75,515.63	$75,515.63	$75,515.[illegible]	$75,515.63	$75,515.63	$75,515.63

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Communit, pop = 400)								
a) Emergency Health Care								
-lives saved (0.74/yr)	Annual	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00
	PV	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41
-permanent disabilities	Annual	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00
prevented (1.48/yr)	PV	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39
-temp disability-lost	Annual	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00
work days saved (23.3/yr)	PV	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41
b) Air Service User Time	Annual	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00
Savings (5,024 hrs/yr)	PV	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69

c) Employment (person-yrs)

-long term (annual)	-local	1.8							
	-rest of Manitoba	0							
	-rest of Canada	0							
	-total	1.8							
-short term direct:									
civil works	-local		2.43	2.38	2.53	2.59	3.88	3.22	2.91
	-rest of Manitoba		2.43	2.38	2.53	2.59	3.88	3.22	2.91
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		4.87	4.76	5.06	5.19	7.76	6.43	5.83
ATB	-local		0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba		0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local		0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba		0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local		0.40	0.40	0.40	0.40	0.40	0.40	0.40
	-rest of Manitoba		1.71	1.72	1.69	1.69	1.72	1.69	1.69
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		2.10	2.12	2.09	2.09	2.12	2.09	2.09
SUBTOTAL	-local		3.44	3.39	3.53	3.60	4.89	4.22	3.92
	-rest of Manitoba		4.90	4.86	4.98	5.04	6.36	5.66	5.36
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		8.34	8.25	8.51	8.64	11.25	9.89	9.28

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.09	2.05	2.18	2.24	3.34	2.79	2.52
	-rest of Canada	2.19	2.14	2.28	2.34	3.50	2.92	2.63
	-total	4.28	4.19	4.47	4.58	6.84	5.70	5.15
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.04	0.04	0.04	0.04	0.04	0.04	0.04
	-rest of Canada	0.02	0.02	0.02	0.02	0.02	0.02	0.02
	-total	0.06	0.06	0.05	0.05	0.06	0.05	0.05
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.52	2.47	2.61	2.66	3.77	3.21	2.94
	-rest of Canada	2.34	2.29	2.43	2.49	3.65	3.07	2.78
	-total	4.85	4.76	5.04	5.15	7.42	6.28	5.72
TOTAL SHORT TERM	-local	3.44	3.39	3.53	3.60	4.89	4.22	3.92
	-rest of Manitoba	7.41	7.33	7.58	7.70	10.13	8.86	8.30
	-rest of Canada	2.34	2.29	2.43	2.49	3.65	3.07	2.78
	-total	13.19	13.02	13.55	13.79	18.66	16.16	15.00
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,275,685.42	$1,265,919.01	$1,250,987.21	$1,263,151.25	$1,550,879.59	$2,045,693.69	$1,323,971.45
- Risk Level 1		$1,283,456.33	$1,273,590.93	$1,258,760.13	$1,270,924.17	$1,558,652.51	$2,053,466.61	$1,331,744.37
- Risk Level 2		$1,291,231.25	$1,281,262.35	$1,266,533.05	$1,278,697.09	$1,566,425.43	$2,061,239.53	$1,339,517.29
- Risk Level 3		$1,306,777.09	$1,296,909.68	$1,282,078.88	$1,294,242.92	$1,581,971.26	$2,076,795.36	$1,355,063.12
TOTAL PV INCREMENTAL BENEFITS		$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90
PVB/PVC (INCREMENTAL)								
- Risk Level 0		1.96306	1.97836	2.00182	1.98254	1.61477	1.22411	1.89147
- Risk Level 1		1.95117	1.96629	1.98946	1.97042	1.60668	1.21952	1.88043
- Risk Level 2		1.93943	1.95451	1.97725	1.95844	1.59870	1.21492	1.86952
- Risk Level 3		1.91636	1.93094	1.95327	1.93491	1.58299	1.20583	1.84807

TABLE 6.15
AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS

A/C: DHC-6
Temp: 15 C
Elev: 0 ft
STOW: 10000 lbs
CAR-3

(non-instrument runway)

a)

CIVIL WORKS	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
			PAVEMENT TYPE (P)				
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)	$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)	$199,996.18	$198,075.40	$203,779.55	$206,965.05	$272,591.65	$412,429.80	$222,692.55
Subtotals	$353,633.68	$348,050.40	$372,067.05	$382,577.55	$591,041.65	$1,060,504.80	$435,130.05

(strip length = 328 m.)
(graded area width = 38 m.)
(runway pavement width = 15.2 m. max to 7.6 m. min)
(runway pavement length = 268 m.);gravel= 273 ; turf= 279

Civil works Subtotals:	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
3+4+5 :	$222,183.68	$219,400.40	$229,417.05	$234,327.55	$333,591.65	$551,054.80	$258,880.05

b) AIR TERMINAL BUILDING AND RELATED UTILITIES

	Cost
Air Terminal Building	$12,000.00
Water Supply	$5,200.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$50,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachments	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$14,134.00
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$78,734.00

Grand Totals	$632,367.68	$626,784.40	$650,801.05	$661,711.55	$869,775.65	$1,339,238.80	$713,864.05

			Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing			(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
		Constant $	$6,452.93	$6,534.86	$9,556.50	$9,556.50	$6,452.93	$0.00	$9,556.50
		PV	$2,487.86	$2,519.45	$1,341.69	$1,341.69	$2,487.86	$0.00	$1,341.69
f) O & M		Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
		PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Emerg. Serv. DOC		Annual	$189.81	$189.81	$187.00	$187.00	$189.81	$187.00	$187.00
		PV	$1,615.92	$1,615.92	$1,592.04	$1,592.04	$1,615.92	$1,592.04	$1,592.04
h) Incremental Reg. Pass. Serv. DOC (60% LF)		Annual	$3,731.14	$3,731.14	$3,676.00	$3,676.00	$3,731.14	$3,676.00	$3,676.00
		PV	$31,765.43	$31,765.43	$31,295.99	$31,295.99	$31,765.43	$31,295.99	$31,295.99
i) Incremental A/C Accident Costs	Risk Level 0	Annual	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00
		PV	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96
	Risk Level 1 (1.5X)	Annual	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00
		PV	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88
	Risk Level 2 (2X)	Annual	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00
		PV	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80
	Risk Level 3 (3X)	Annual	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00
		PV	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 400)								
a) Emergency Health Care								
-lives saved (0.74/yr)	Annual	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00
	PV	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41
-permanent disabilities	Annual	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00
prevented (1.48/yr)	PV	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39
-temp disability-lost	Annual	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00
work days saved (23.3/yr)	PV	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41
b) Air Service User Time	Annual	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00
Savings (5,024 hrs/yr)	PV	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69

c) Employment (person-yrs)

-long term (annual)	-local	1.8							
	-rest of Manitoba	0							
	-rest of Canada	0							
	-total	1.8							
-short term direct:									
civil works	-local		1.87	1.84	1.96	2.02	3.12	2.64	2.29
	-rest of Manitoba		1.87	1.84	1.96	2.02	3.12	2.64	2.29
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		3.74	3.68	3.92	4.03	6.23	5.28	4.58
ATB	-local		0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba		0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local		0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba		0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local		0.36	0.36	0.36	0.36	0.36	0.36	0.36
	-rest of Manitoba		1.53	1.54	1.52	1.52	1.54	1.52	1.52
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.90	1.91	1.88	1.88	1.91	1.88	1.88
SUBTOTAL	-local		2.84	2.82	2.93	2.99	4.09	3.61	3.26
	-rest of Manitoba		4.16	4.14	4.24	4.30	5.42	4.92	4.57
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		7.00	6.96	7.17	7.28	9.51	8.53	7.84

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.61	1.58	1.69	1.74	2.69	2.29	1.98
	-rest of Canada	1.68	1.66	1.77	1.82	2.81	2.39	2.07
	-total	3.29	3.24	3.46	3.56	5.50	4.68	4.05
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.04	0.04	0.04	0.04	0.04	0.04	0.04
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.02	2.00	2.11	2.15	3.10	2.70	2.39
	-rest of Canada	1.83	1.80	1.92	1.97	2.96	2.54	2.22
	-total	3.85	3.80	4.02	4.12	6.06	5.24	4.61
TOTAL SHORT TERM	-local	2.84	2.82	2.93	2.99	4.09	3.61	3.26
	-rest of Manitoba	6.18	6.14	6.35	6.45	8.52	7.62	6.97
	-rest of Canada	1.83	1.80	1.92	1.97	2.96	2.54	2.22
	-total	10.85	10.76	11.19	11.40	15.57	13.78	12.44
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,162,775.69	$1,157,224.01	$1,137,001.57	$1,147,512.07	$1,400,183.66	$1,824,097.63	$1,200,064.57
- Risk Level 1		$1,170,548.61	$1,164,996.92	$1,144,774.49	$1,155,284.99	$1,407,956.58	$1,831,870.55	$1,207,837.49
- Risk Level 2		$1,178,321.53	$1,172,769.84	$1,152,547.41	$1,163,057.91	$1,415,729.49	$1,839,643.47	$1,215,610.41
- Risk Level 3		$1,193,867.36	$1,188,315.67	$1,168,093.24	$1,178,603.74	$1,431,275.33	$1,855,189.30	$1,231,156.24
TOTAL PV INCREMENTAL BENEFITS		$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90
PVB/PVC (INCREMENTAL)								
- Risk Level 0		2.15368	2.16401	2.20250	2.18233	1.78852	1.37287	2.08676
- Risk Level 1		2.13938	2.14958	2.18755	2.16765	1.77864	1.36705	2.07333
- Risk Level 2		2.12527	2.13533	2.17230	2.15316	1.76888	1.36127	2.06008
- Risk Level 3		2.09759	2.10739	2.14388	2.12476	1.74965	1.34986	2.03406

TABLE G.16
AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS

A/C: DHC-6
Temp: 15 C
Elev: 0 ft
GTOW: 12500 lbs
(non-instrument runway) CAR-3

a)

CIVIL WORKS	PAVEMENT TYPE (P) Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$145,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,537.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)	$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)	$283,474.20	$278,033.73	$289,693.02	$293,181.54	$385,804.59	$582,691.08	$315,624.14
Subtotals	$437,111.70	$428,008.73	$456,980.52	$468,794.04	$704,254.59	$1,230,766.08	$527,861.64

(strip length = 499 m.)
(graded area width = 38 m.)
(runway pavement width = 15.2 m. max to 7.6 m. min)
(runway pavement length = 439 m.);gravel= 447 ; turf= 455

Civil works Subtotals:		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
	1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
	3+4+5 :	$305,661.70	$299,358.73	$314,330.52	$320,544.04	$446,904.59	$721,316.08	$351,611.54

b) AIR TERMINAL BUILDING AND RELATED UTILITIES

	Cost
Air Terminal Building	$15,000.00
Water Supply	$5,800.00
Sewage Disposal	$1,500.00
Power Generation	$30,000.00
Communications	$6,500.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachments	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$18,494.50
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$83,094.50

Grand Totals	$720,206.20	$711,103.23	$740,075.02	$751,688.54	$987,349.09	$1,513,860.58	$810,956.14

		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing		(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
	Constant $	$9,096.03	$9,215.03	$13,465.56	$13,465.56	$9,096.03	$0.00	$13,465.56
	PV	$3,506.88	$3,552.76	$1,890.51	$1,890.51	$3,506.88	$0.00	$1,890.51
f) O $ M	Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
	PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Emerg. Serv. DOC	Annual	$189.81	$189.81	$187.00	$187.00	$189.81	$187.00	$187.00
	PV	$1,615.92	$1,615.92	$1,592.04	$1,592.04	$1,615.92	$1,592.04	$1,592.04
h) Incremental Reg. Pass. Serv. DOC (60% LF)	Annual	$3,731.14	$3,731.14	$3,676.00	$3,676.00	$3,731.14	$3,676.00	$3,676.00
	PV	$31,765.43	$31,765.43	$31,295.99	$31,295.99	$31,765.43	$31,295.99	$31,295.99
i) Incremental A/C Accident Costs								
Risk Level 0	Annual	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00
	PV	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96
Risk Level 1 (1.5X)	Annual	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00
	PV	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88
Risk Level 2 (2X)	Annual	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00
	PV	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80
Risk Level 3 (3X)	Annual	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00
	PV	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 400)								
a) Emergency Health Care								
-lives saved (0.74/yr)	Annual	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00
	PV	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41
-permanent disabilities	Annual	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00
prevented (1.48/yr)	PV	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39
-temp disability-lost	Annual	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00
work days saved (23.3/yr)	PV	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41
b) Air Service User Time	Annual	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00
Savings (5,024 hrs/yr)	PV	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69

c) Employment (person-yrs)

-long term (annual)	-local	1.8							
	-rest of Manitoba	0							
	-rest of Canada	0							
	-total	1.8							
-short term direct:									
civil works	-local		2.31	2.27	2.41	2.47	3.72	3.09	2.78
	-rest of Manitoba		2.31	2.27	2.41	2.47	3.72	3.09	2.78
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		4.63	4.53	4.82	4.94	7.43	6.19	5.56
ATB	-local		0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba		0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local		0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba		0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local		0.39	0.39	0.39	0.39	0.39	0.39	0.39
	-rest of Manitoba		1.67	1.68	1.65	1.65	1.68	1.65	1.65
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		2.06	2.08	2.04	2.04	2.08	2.04	2.04
SUBTOTAL	-local		3.31	3.27	3.41	3.47	4.72	4.09	3.78
	-rest of Manitoba		4.74	4.71	4.82	4.88	6.16	5.51	5.19
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		8.05	7.98	8.23	8.35	10.88	9.60	8.97

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.99	1.95	2.08	2.13	3.20	2.68	2.40
	-rest of Canada	2.08	2.04	2.18	2.23	3.35	2.81	2.51
	-total	4.07	3.98	4.25	4.36	6.56	5.49	4.91
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.04	0.04	0.04	0.04	0.04	0.04	0.04
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.05	0.05	0.05	0.05	0.05	0.05	0.05
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.41	2.37	2.50	2.55	3.63	3.10	2.82
	-rest of Canada	2.23	2.19	2.32	2.38	3.50	2.95	2.66
	-total	4.64	4.56	4.82	4.93	7.13	6.06	5.48
TOTAL SHORT TERM	-local	3.31	3.27	3.41	3.47	4.72	4.09	3.78
	-rest of Manitoba	7.15	7.08	7.32	7.44	9.78	8.61	8.02
	-rest of Canada	2.23	2.19	2.32	2.38	3.50	2.95	2.66
	-total	12.69	12.53	13.05	13.29	18.09	15.65	14.46
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,251,633.24	$1,242,576.14	$1,226,824.36	$1,238,637.69	$1,513,776.12	$1,998,719.41	$1,297,705.43
- Risk Level 1		$1,259,406.16	$1,250,349.06	$1,234,597.23	$1,246,410.80	$1,526,549.04	$2,006,492.33	$1,305,478.46
- Risk Level 2		$1,267,179.08	$1,258,121.93	$1,242,370.19	$1,254,187.71	$1,534,321.96	$2,014,265.25	$1,313,251.31
- Risk Level 3		$1,282,724.51	$1,273,667.81	$1,257,916.03	$1,269,729.55	$1,549,867.79	$2,029,811.08	$1,328,797.15
TOTAL PV INCREMENTAL BENEFITS		$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90
PVB PVC (INCREMENTAL)								
- Risk Level 0		2.00078	2.01537	2.04125	2.02178	1.65431	1.25293	1.92975
- Risk Level 1		1.98844	2.00284	2.02839	2.00917	1.64046	1.24807	1.91826
- Risk Level 2		1.97624	1.99047	2.01570	1.99671	1.63215	1.24326	1.90691
- Risk Level 3		1.95227	1.96617	1.99079	1.97227	1.61578	1.23371	1.88460

TABLE G.17
AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS

A/C: DHC-6
Temp: -18 C
Elev: 1000 ft
GTOW: 10000 lbs
C4R-3

(non-instrument runway)

a)

CIVIL WORKS	PAVEMENT TYPE (P)						
	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)	$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)	$191,085.80	$189,425.95	$194,841.29	$197,889.63	$260,507.38	$394,507.56	$213,131.33
Subtotals	$344,723.30	$339,400.95	$363,128.79	$373,502.13	$578,957.38	$1,042,582.56	$425,368.83

(strip length = 310 m.)
(graded area width = 38 m.)
(runway pavement width = 15.2 m. max to 7.6 m. min)
(runway pavement length = 250 m.);gravel= 255 ; turf= 260

Civil works Subtotals:		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
	1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
	3+4+5 :	$213,273.30	$210,750.95	$220,478.79	$225,252.13	$321,507.38	$533,132.56	$249,118.83

b) AIR TERMINAL BUILDING AND
RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,800.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachments	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$13,675.00
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$78,275.00

Grand Totals	$622,998.30	$617,575.95	$641,403.79	$651,777.13	$857,232.38	$1,320,857.56	$703,643.83

		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing		(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
	Constant $	$6,170.81	$6,244.93	$9,145.02	$9,145.02	$6,170.81	$0.00	$9,145.02
	PV	$2,379.09	$2,407.67	$1,283.92	$1,283.92	$2,379.09	$0.00	$1,283.92
f) O $ M	Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
	PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Emerg. Serv. DOC	Annual	$189.81	$189.81	$187.00	$187.00	$189.81	$187.00	$187.00
	PV	$1,615.92	$1,615.92	$1,592.04	$1,592.04	$1,615.92	$1,592.04	$1,592.04
h) Incremental Reg. Pass. Serv. DOC	Annual	$3,731.14	$3,731.14	$3,676.00	$3,676.00	$3,731.14	$3,676.00	$3,676.00
(60% LF)	PV	$31,765.43	$31,765.43	$31,295.99	$31,295.99	$31,765.43	$31,295.99	$31,295.99
i) Incremental A/C Accident Costs								
Risk Level 0	Annual	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00
	PV	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96
Risk Level 1	Annual	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00
(1.5X)	PV	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88
Risk Level 2	Annual	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00
(2X)	PV	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80
Risk Level 3	Annual	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00
(3X)	PV	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 400)								
a) Emergency Health Care								
-lives saved (0.74/yr)	Annual	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00
	PV	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41
-permanent disabilities	Annual	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00
prevented (1.48/yr)	PV	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39
-temp disability-lost	Annual	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00
work days saved (23.3/yr)	PV	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41
b) Air Service User Time	Annual	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00
Savings (5,024 hrs/yr)	PV	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69

c) Employment (person-yrs)

-long term (annual)	-local	1.8							
	-rest of Manitoba	0							
	-rest of Canada	0							
	-total	1.8							
-short term direct:									
civil works	-local		1.82	1.79	1.91	1.97	3.05	2.59	2.24
	-rest of Manitoba		1.82	1.79	1.91	1.97	3.05	2.59	2.24
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		3.64	3.59	3.83	3.94	6.10	5.19	4.48
ATB	-local		0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba		0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local		0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba		0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local		0.36	0.36	0.36	0.36	0.36	0.36	0.36
	-rest of Manitoba		1.52	1.53	1.51	1.51	1.53	1.51	1.51
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.88	1.87	1.87	1.87	1.89	1.87	1.87
SUBTOTAL	-local		2.79	2.77	2.88	2.94	4.02	3.56	3.21
	-rest of Manitoba		4.10	4.08	4.18	4.24	5.34	4.86	4.51
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		6.89	6.85	7.06	7.17	9.36	8.42	7.72

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.57	1.54	1.65	1.70	2.63	2.25	1.94
	-rest of Canada	1.64	1.62	1.73	1.70	2.76	2.35	2.02
	-total	3.21	3.16	3.38	3.40	5.39	4.60	3.96
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.04	0.04	0.04	0.04	0.04	0.04	0.04
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.98	1.96	2.06	2.11	3.05	2.66	2.35
	-rest of Canada	1.79	1.76	1.87	1.92	2.90	2.50	2.17
	-total	3.77	3.72	3.94	4.03	5.95	5.15	4.52
TOTAL SHORT TERM	-local	2.79	2.77	2.88	2.94	4.02	3.56	3.21
	-rest of Manitoba	6.08	6.04	6.24	6.35	8.38	7.52	6.85
	-rest of Canada	1.79	1.76	1.87	1.92	2.90	2.50	2.17
	-total	10.66	10.56	11.00	11.20	15.31	13.58	12.23
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,153,297.54	$1,148,003.78	$1,127,546.54	$1,137,919.38	$1,387,531.63	$1,805,716.29	$1,189,786.58
- Risk Level 1		$1,161,070.46	$1,155,776.69	$1,135,319.46	$1,145,692.80	$1,395,304.54	$1,813,489.31	$1,197,559.50
- Risk Level 2		$1,168,843.38	$1,163,549.61	$1,143,092.38	$1,153,465.72	$1,403,077.46	$1,821,262.03	$1,205,332.42
- Risk Level 3		$1,194,399.21	$1,179,095.44	$1,158,638.21	$1,169,011.55	$1,418,623.29	$1,836,808.06	$1,220,878.25
TOTAL PV INCREMENTAL BENEFITS		$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90
PVB/PVC (INCREMENTAL)								
- Risk Level 0		2.17138	2.18140	2.22097	2.20073	1.80482	1.38685	2.10479
- Risk Level 1		2.15685	2.16672	2.20577	2.18580	1.79477	1.38090	2.09113
- Risk Level 2		2.14250	2.15225	2.19077	2.17107	1.78463	1.37501	2.07764
- Risk Level 3		2.11423	2.12387	2.16137	2.14219	1.76527	1.36337	2.05119

TABLE G.18
AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS

A/C: DHC-6
Temp: -18 C
Elev: 1000 ft
GTOW: 12500 lbs
CAR-3

(non-instrument runway)

a)

CIVIL WORKS	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
			PAVEMENT TYPE (P)				
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,937.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)	$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)	$276,161.84	$271,039.24	$281,244.47	$285,618.69	$375,887.55	$567,755.38	$307,489.79
Subtotals	$429,799.34	$421,014.24	$449,531.97	$461,231.19	$694,337.55	$1,215,830.88	$519,727.29

(strip length = 484 m.)
(graded area width = 38 m.)
(runway pavement width = 15.2 m. max to 7.6 m. min)
(runway pavement length = 424 m.);gravel= 432 ; turf= 439

Civil works Subtotals:	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
3+4+5 :	$298,349.34	$292,364.24	$306,881.97	$312,981.19	$436,887.55	$706,380.88	$343,477.29

b) AIR TERMINAL BUILDING AND RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,300.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$59,500.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachments	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$18,112.00
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$82,712.00

Grand Totals	$712,511.34	$703,726.24	$732,243.97	$743,943.19	$977,049.55	$1,498,542.98	$802,439.29

			Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
			(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
e) Resurfacing		Constant $	$8,864.51	$8,980.58	$13,122.66	$13,122.66	$8,864.51	$0.00	$13,122.66
		PV	$3,417.62	$3,462.37	$1,842.37	$1,842.37	$3,417.62	$0.00	$1,842.37
f) O & M		Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
		PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Emerg. Serv. DOC		Annual	$189.81	$189.81	$187.00	$187.00	$189.81	$187.00	$187.00
		PV	$1,615.92	$1,615.92	$1,592.04	$1,592.04	$1,615.92	$1,592.04	$1,592.04
h) Incremental Reg. Pass. Serv. DOC (60% LF)		Annual	$3,731.14	$3,731.14	$3,676.00	$3,676.00	$3,731.14	$3,676.00	$3,676.00
		PV	$31,765.43	$31,765.43	$31,295.99	$31,295.99	$31,765.43	$31,295.99	$31,295.99
i) Incremental A/C Accident Costs	Risk Level 0	Annual	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00
		PV	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96
	Risk Level 1 (1.5X)	Annual	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00
		PV	$52,196.88	$52,196.89	$52,196.89	$52,196.88	$52,196.88	$52,196.88	$52,196.88
	Risk Level 2 (2X)	Annual	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00
		PV	$59,967.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80
	Risk Level 3 (3X)	Annual	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00
		PV	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63

j) Mobile Equipment Replacement								
-pickup truck (5 yrs.)	Constant $ PV	$15,000.00 $18,810.33	$15,000.00 $18,810.33	$15,000.00 $18,810.33	$15,000.00 $18,810.33	$15,000.00 $18,810.33	$15,000.00 $18,810.33	$15,000.00 $18,810.33
-5 ton truck (10 yrs.)	Constant $ PV	$40,000.00 $15,421.60	$40,000.00 $15,421.60	$40,000.00 $15,421.60	$40,000.00 $15,421.60	$40,000.00 $15,421.60	$40,000.00 $15,421.60	$40,000.00 $15,421.60
-tractor-loader (10 yrs.)	Constant $ PV	$60,000.00 $23,132.40	$60,000.00 $23,132.40	$60,000.00 $23,132.40	$60,000.00 $23,132.40	$60,000.00 $23,132.40	$60,000.00 $23,132.40	$60,000.00 $23,132.40
-attachments (10 yrs.)	Constant $ PV	$25,000.00 $9,638.50	$25,000.00 $9,638.50	$25,000.00 $9,638.50	$25,000.00 $9,638.50	$25,000.00 $9,638.50	$25,000.00 $9,638.50	$25,000.00 $9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 400)								
a) Emergency Health Care								
-lives saved (0.74/yr)	Annual PV	$175,949.00 $1,497,959.41	$175,949.00 $1,497,959.41	$175,949.00 $1,497,959.41	$175,949.00 $1,497,959.41	$175,949.00 $1,497,959.41	$175,949.00 $1,497,959.41	$175,949.00 $1,497,959.41
-permanent disabilities prevented (1.48/yr)	Annual PV	$68,301.00 $581,487.39	$68,301.00 $581,487.39	$68,301.00 $581,487.39	$68,301.00 $581,487.39	$68,301.00 $581,487.39	$68,301.00 $581,487.39	$68,301.00 $581,487.39
-temp disability-lost work days saved (23.3/yr)	Annual PV	$324.00 $2,758.41	$324.00 $2,758.41	$324.00 $2,758.41	$324.00 $2,758.41	$324.00 $2,758.41	$324.00 $2,758.41	$324.00 $2,758.41
b) Air Service User Time Savings (5,024 hrs/yr)	Annual PV	$49,573.00 $422,044.69	$49,573.00 $422,044.69	$49,573.00 $422,044.69	$49,573.00 $422,044.69	$49,573.00 $422,044.69	$49,573.00 $422,044.69	$49,573.00 $422,044.69

c) Employment (person-yrs)

-long term (annual)	-local	1.8							
	-rest of Manitoba	0							
	-rest of Canada	0							
	-total	1.8							
-short term direct:									
civil works	-local		2.27	2.23	2.37	2.43	3.66	3.05	2.74
	-rest of Manitoba		2.27	2.23	2.37	2.43	3.66	3.05	2.74
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		4.55	4.46	4.74	4.86	7.33	6.11	5.48
ATB	-local		0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba		0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local		0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba		0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local		0.39	0.39	0.39	0.39	0.39	0.39	0.39
	-rest of Manitoba		1.66	1.67	1.64	1.64	1.67	1.64	1.64
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		2.05	2.06	2.03	2.03	2.06	2.03	2.03
SUBTOTAL	-local		3.27	3.23	3.37	3.43	4.66	4.05	3.73
	-rest of Manitoba		4.69	4.66	4.77	4.83	6.09	5.46	5.14
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		7.96	7.89	8.14	8.26	10.76	9.51	8.37

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.96	1.92	2.05	2.10	3.16	2.65	2.36
	-rest of Canada	2.05	2.00	2.14	2.20	3.31	2.77	2.47
	-total	4.00	3.92	4.19	4.29	6.46	5.42	4.84
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.04	0.04	0.04	0.04	0.04	0.04	0.04
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.05	0.05	0.05	0.05	0.05	0.05	0.05
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.38	2.34	2.47	2.52	3.58	3.07	2.78
	-rest of Canada	2.19	2.15	2.29	2.34	3.45	2.92	2.62
	-total	4.57	4.49	4.75	4.86	7.03	5.98	5.41
TOTAL SHORT TERM	-local	3.27	3.23	3.37	3.43	4.66	4.05	3.73
	-rest of Manitoba	7.07	6.99	7.24	7.35	9.67	8.52	7.92
	-rest of Canada	2.19	2.15	2.29	2.34	3.45	2.92	2.62
	-total	12.53	12.38	12.89	13.12	17.79	15.49	14.28
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,243,849.11	$1,235,108.76	$1,218,945.17	$1,230,644.39	$1,508,397.33	$1,983,401.71	$1,289,140.49
- Risk Level 1		$1,251,622.03	$1,242,881.56	$1,226,718.08	$1,238,417.30	$1,516,160.24	$1,991,174.63	$1,296,913.40
- Risk Level 2		$1,259,394.95	$1,250,654.60	$1,234,491.00	$1,246,190.22	$1,523,933.16	$1,998,947.55	$1,304,686.32
- Risk Level 3		$1,274,940.78	$1,266,200.43	$1,250,036.83	$1,261,736.05	$1,539,478.99	$2,014,493.38	$1,320,232.15
TOTAL PV INCREMENTAL BENEFITS		$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90
PVB/PVC (INCREMENTAL)								
- Risk Level 0		2.01331	2.02755	2.05444	2.03491	1.66022	1.26260	1.94257
- Risk Level 1		2.00080	2.01487	2.04142	2.02214	1.65171	1.25767	1.93093
- Risk Level 2		1.98845	2.00235	2.02557	2.00952	1.64328	1.25278	1.91943
- Risk Level 3		1.96421	1.97777	2.00334	1.98477	1.62669	1.24312	1.89683

TABLE 6.19
AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS

A/C: CIT II
Temp: 22 C
Elev: 1000 ft
GTOW: 11000 lbs

(non-instrument runway)

a)
CIVIL WORKS

		PAVEMENT TYPE (P)					
	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 10.5 m.) (taxiway length = 40 m.)	$5,040.00	$4,830.00	$5,880.00	$6,300.00	$14,490.00	$33,390.00	$8,400.00
5. Runway (non-instrument)	$455,166.80	$450,180.57	$445,034.23	$453,077.08	$644,048.83	$971,840.90	$493,291.33
Subtotals	$610,244.30	$601,535.57	$615,001.73	$630,489.58	$966,638.83	$1,629,455.90	$707,928.83

(strip length = 794 m.)
(graded area width = 38 m.)
(runway pavement width = 18 m. max to 9.1 m. min)
(runway pavement length = 734 m.);gravel= 785 ; turf= 818

Civil works Subtotals:		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
	1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
	3+4+5 :	$478,794.30	$472,885.57	$472,351.73	$482,239.59	$709,188.83	$1,120,005.90	$531,678.83

b) AIR TERMINAL BUILDING AND
RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,800.00
Sewage Disposal	$1,200.00
Power Generation	$30,000.00
Communications	$6,500.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachaents	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$26,017.00
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$90,617.00

Grand Totals	$900,861.30	$892,152.57	$905,618.73	$921,106.58	$1,257,255.83	$1,920,072.90	$998,545.63

		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing		(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
	Constant $	$16,789.51	$17,246.29	$24,128.55	$24,128.55	$16,789.51	$0.00	$24,128.55
	PV	$6,473.03	$6,649.13	$3,387.55	$3,387.55	$6,473.03	$0.00	$3,387.55
f) O & M	Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
	PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Emerg. Serv. DOC	Annual	$12,200.30	$12,200.30	$12,020.00	$12,020.00	$12,200.30	$12,020.00	$12,020.00
	PV	$103,868.47	$103,868.47	$102,333.47	$102,333.47	$103,868.47	$102,333.47	$102,333.47
h) Incremental Reg. Pass. Serv. DOC	Annual	$4,989.74	$4,989.74	$4,916.00	$4,916.00	$4,989.74	$4,916.00	$4,916.00
(60% LF)	PV	$42,480.65	$42,480.65	$41,852.86	$41,852.86	$42,480.65	$41,852.86	$41,852.86
i) Incremental A/C Accident Costs								
Risk Level 0	Annual	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00
	PV	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96
Risk Level 1 (1.5X)	Annual	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00
	PV	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88
Risk Level 2 (2X)	Annual	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00
	PV	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80
Risk Level 3 (3X)	Annual	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00
	PV	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63

j) Mobile Equipment Replacement								
-pickup truck (5 yrs.)	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck (10 yrs.)	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader (10 yrs.)	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments (10 yrs.)	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 400)								
a) Emergency Health Care								
-lives saved (0.74/yr)	Annual	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00
	PV	$1,497,957.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41
-permanent disabilities prevented (1.48/yr)	Annual	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00
	PV	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39
-temp disability-lost work days saved (23.3/yr)	Annual	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00
	FV	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41
b) Air Service User Time Savings (5,024 hrs/yr)	Annual	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00
	FV	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69

c) Employment (person-yrs)

-long term (annual)	-local	1.8
	-rest of Manitoba	0
	-rest of Canada	0
	-total	1.8

-short term direct:

civil works	-local	3.24	3.19	3.25	3.33	5.11	4.37	3.73
	-rest of Manitoba	3.24	3.19	3.25	3.33	5.11	4.37	3.73
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	6.48	6.39	6.49	6.66	10.22	8.74	7.47
ATB	-local	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba	0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local	0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba	0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local	0.44	0.44	0.43	0.43	0.44	0.43	0.43
	-rest of Manitoba	1.89	1.90	1.88	1.88	1.90	1.88	1.88
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	2.33	2.33	2.32	2.32	2.33	2.32	2.32
SUBTOTAL	-local	4.28	4.24	4.29	4.37	6.16	5.41	4.78
	-rest of Manitoba	5.89	5.85	5.89	5.97	7.76	7.01	6.37
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	10.17	10.09	10.18	10.34	13.92	12.43	11.15

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.78	2.74	2.80	2.87	4.40	3.79	3.22
	-rest of Canada	2.90	2.86	2.93	3.00	4.60	3.96	3.37
	-total	5.68	5.60	5.73	5.87	9.00	7.75	6.59
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	-rest of Canada	0.02	0.02	0.02	0.02	0.02	0.02	0.02
	-total	0.07	0.07	0.07	0.07	0.07	0.07	0.07
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	3.21	3.17	3.23	3.30	4.83	4.22	3.66
	-rest of Canada	3.06	3.02	3.08	3.16	4.76	4.12	3.52
	-total	6.27	6.19	6.32	6.46	9.59	8.34	7.18
TOTAL SHORT TERM	-local	4.28	4.24	4.29	4.37	6.16	5.41	4.78
	-rest of Manitoba	9.10	9.02	9.12	9.27	12.60	11.23	10.03
	-rest of Canada	3.06	3.02	3.08	3.16	4.76	4.12	3.52
	-total	16.44	16.28	16.49	16.80	23.51	20.77	18.33
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,548,222.24	$1,539,689.63	$1,505,162.40	$1,520,851.25	$1,904,616.78	$2,516,230.03	$1,598,090.50
- Risk Level 1		$1,555,775.16	$1,547,462.54	$1,512,936.31	$1,526,424.16	$1,912,389.70	$2,524,002.94	$1,605,863.41
- Risk Level 2		$1,563,768.08	$1,555,235.45	$1,520,709.22	$1,536,197.06	$1,920,162.61	$2,531,775.86	$1,613,636.33
- Risk Level 3		$1,571,213.91	$1,570,781.10	$1,536,255.06	$1,551,742.91	$1,935,708.45	$2,547,321.69	$1,629,182.16
TOTAL PV INCREMENTAL BENEFITS		$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90
PVB/PVC (INCREMENTAL)								
- Risk Level 0		1.61750	1.62646	1.66377	1.64487	1.31482	0.99524	1.56703
- Risk Level 1		1.60942	1.61829	1.65522	1.63645	1.30949	0.99217	1.55944
- Risk Level 2		1.60142	1.61021	1.64678	1.62815	1.30419	0.98913	1.55193
- Risk Level 3		1.58566	1.59427	1.63010	1.61157	1.29371	0.98309	1.53712

TABLE G.20
AIRPORT/AIRCRAFT COMBINATION--
SUMMARY OF COSTS AND BENEFITS

A/C: CIT II
Temp: 15 C
Elev: 0 ft
GTOW: 11000 lbs

(non-instrument runway)

a)

			PAVEMENT TYPE (F)				
CIVIL WORKS	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 10.5 m.) (taxiway length = 40 m.)	$5,040.00	$4,830.00	$5,880.00	$6,300.00	$14,490.00	$33,390.00	$8,400.00
5. Runway (non-instru. ent)	$402,084.63	$396,457.50	$393,567.15	$400,685.85	$568,721.91	$859,842.00	$436,279.35
Subtotals	$557,162.13	$549,812.50	$563,534.65	$578,096.35	$891,311.91	$1,517,457.00	$650,916.85

(strip length = 693 m.)
(graded area width = 38 m.)
(runway pavement width = 18 m. max to 9.1 m. min)
(runway pavement length = 633 m.);gravel= 677 ; turf= 706

Civil works Subtotals:		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
	1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
	3+4+5 :	$425,712.13	$421,162.50	$420,884.65	$429,848.35	$633,861.91	$1,008,007.00	$474,666.85

b) AIR TERMINAL BUILDING AND RELATED UTILITIES

	Cost
Air Terminal Building	$15,000.00
Water Supply	$6,800.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachments	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$23,441.50
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$88,041.50

Grand Totals	$845,203.63	$837,554.00	$851,576.15	$866,139.85	$1,179,353.41	$1,805,498.50	$939,759.35

			Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing			(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
		Constant $	$14,912.20	$15,185.25	$21,356.10	$21,356.10	$14,812.20	$0.00	$21,356.10
		PV	$5,710.70	$5,654.52	$2,998.31	$2,998.31	$5,710.70	$0.00	$2,998.31
f) O & M		Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
		PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Emerg. Serv. DOC		Annual	$12,200.30	$12,200.30	$12,020.00	$12,020.00	$12,200.30	$12,020.00	$12,020.00
		PV	$103,868.47	$103,868.47	$102,333.47	$102,333.47	$103,868.47	$102,333.47	$102,333.47
h) Incremental Reg. Pass. Serv. DOC (60% LF)		Annual	$4,989.74	$4,989.74	$4,916.00	$4,916.00	$4,989.74	$4,916.00	$4,916.00
		PV	$42,480.65	$42,480.65	$41,852.86	$41,852.86	$42,480.65	$41,852.86	$41,852.86
i) Incremental A/C Accident Costs									
	Risk Level 0	Annual	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00
		PV	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96
	Risk Level 1 (1.5X)	Annual	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00
		PV	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88
	Risk Level 2 (2X)	Annual	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00
		PV	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80
	Risk Level 3 (3X)	Annual	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00
		PV	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 400)								
a) Emergency Health Care								
-lives saved (0.74/yr)	Annual	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00
	PV	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41
-permanent disabilities	Annual	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00
prevented (1.48/yr)	PV	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39
-temp disability-lost	Annual	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00
work days saved (23.3/yr)	PV	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41
b) Air service User Time	Annual	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00
Savings (5,024 hrs/yr)	PV	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69

c) Employment (person-yrs)

-long term (annual)	-local	1.8							
	-rest of Manitoba	0							
	-rest of Canada	0							
	-total	1.8							
-short term direct:									
civil works	-local		2.96	2.92	2.97	3.05	4.71	4.04	3.43
	-rest of Manitoba		2.96	2.92	2.97	3.05	4.71	4.04	3.43
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		5.91	5.83	5.95	6.10	9.42	8.09	6.87
ATB	-local		0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba		0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local		0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba		0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local		0.42	0.42	0.42	0.42	0.42	0.42	0.42
	-rest of Manitoba		1.81	1.82	1.80	1.80	1.82	1.80	1.80
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		2.23	2.24	2.22	2.22	2.24	2.22	2.22
SUBTOTAL	-local		3.98	3.95	4.00	4.05	5.74	5.07	4.46
	-rest of Manitoba		5.53	5.50	5.54	5.61	7.29	6.60	6.00
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total		9.51	9.44	9.54	9.66	13.03	11.68	10.46

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.54	2.50	2.56	2.63	4.06	3.50	2.96
	-rest of Canada	2.65	2.62	2.68	2.75	4.24	3.67	3.10
	-total	5.19	5.12	5.25	5.38	8.30	7.17	6.06
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.05	0.05	0.05	0.05	0.05	0.05	0.05
	-rest of Canada	0.02	0.02	0.02	0.02	0.02	0.02	0.02
	-total	0.06	0.06	0.06	0.06	0.06	0.06	0.06
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.97	2.93	2.99	3.06	4.49	3.93	3.39
	-rest of Canada	2.80	2.77	2.83	2.90	4.39	3.82	3.25
	-total	5.77	5.70	5.83	5.96	8.88	7.75	6.64
TOTAL SHORT TERM	-local	3.98	3.95	4.00	4.06	5.74	5.07	4.46
	-rest of Manitoba	8.48	8.41	8.53	8.67	11.76	10.54	9.39
	-rest of Canada	2.80	2.77	2.83	2.90	4.39	3.82	3.25
	-total	15.27	15.13	15.37	15.62	21.89	19.43	17.10
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,491,302.25	$1,484,596.44	$1,450,731.56	$1,465,295.22	$1,825,952.03	$2,401,655.52	$1,539,117.78
- Risk Level 1		$1,499,573.16	$1,492,767.35	$1,458,504.50	$1,473,0[illegible]	$1,833,724.95	$2,409,428.54	$1,545,951.70
- Risk Level 2		$1,507,342.08	$1,50[illegible],142.27	$1,466,277.41	$1,48[illegible],541.[illegible]	$1,841,497.86	$2,417,201.46	$1,557,559.61
- Risk Level 3		$1,522,897.91	$1,5[illegible]	$1,481,823.25	$1,496,336.[illegible]	$1,857,043.70	$2,432,747.29	$1,569,215.45
TOTAL PV INCREMENTAL BENEFITS		$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90
PVB PVC (INCREMENTAL)								
- Risk Level 0		1.67923	1.68682	1.72620	[illegible]	1.37139	1.04272	1.62917
- Risk Level 1		1.66997	[illegible]	1.71699	[illegible]	1.36562	1.03932	1.61994
- Risk Level 2		1.66137	[illegible]	1.70790	[illegible]	[illegible]	1.03601	1.61164
- Risk Level 3		1.64440	[illegible]	1.68998	[illegible]	1.34851	1.02939	1.59587

TABLE 6.21
TRANSPORT CANADA STANDARD CLASS 2B AIRPORT
SUMMARY OF COSTS AND BENEFITS

(non-instrument runway)

a)

CIVIL WORKS			PAVEMENT TYPE (P)				
	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long; 10m wide; 7m paved)	$160,000.00	$153,000.00	$188,000.00	$202,000.00	$475,000.00	$1,105,000.00	$272,000.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 10.5 m.) (taxiway length = 40 m.)	$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)	$689,947.92	$682,342.90	$732,257.50	$755,507.83	$1,216,926.62	$2,255,154.25	$871,759.49
Subtotals	$873,335.42	$857,817.90	$947,295.00	$986,370.33	$1,756,376.62	$3,506,729.25	$1,181,746.99
(strip length = 1034 m.)							
(graded area width = 44 m.)							
(runway pavement width = 23 m.)							
(runway pavement length = 914 m.);gravel=	930 ;	turf=	946				
Civil works Subtotals: 1+2 :	$161,200.00	$154,150.00	$189,400.00	$203,500.00	$478,450.00	$1,112,950.00	$274,000.00
3+4+5 :	$712,135.42	$703,667.90	$757,895.00	$782,870.33	$1,277,926.62	$2,393,779.25	$907,746.99

b) AIR TERMINAL BUILDING AND RELATED UTILITIES

	Cost
Air Terminal Building	$174,720.00
Water Supply	$5,800.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$218,720.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	$15,000.00	5 yr.
5 ton truck	$40,000.00	10 yr.
Tractor - loader	$60,000.00	10 yr.
attachments	$25,000.00	10 yr.
Subtotal	$140,000.00	

d)
LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$15,500.00
Edge Lighting	$30,607.00
Illuminated Wind Indicator	$4,050.00
Nondirectional Beacon (NDB)	$100,000.00
Subtotal	$150,157.00

Grand Totals (PV) $1,382,212.42 $1,366,694.90 $1,456,172.00 $1,495,247.33 $2,265,255.62 $4,015,606.25 $1,690,623.99

		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
e) Resurfacing		(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)	(15 yrs)
	Constant $	$19,295.27	$19,103.25	$28,582.86	$28,582.86	$19,295.27	$0.00	$28,582.86
	PV	$7,439.10	$7,365.07	$4,012.91	$4,012.91	$7,439.10	$0.00	$4,012.91
f) O & M	Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00	$40,000.00
	PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00	$340,544.00
g) Incremental A/C Emerg. Serv. DOC	Annual	$189.81	$189.81	$187.00	$187.00	$189.81	$187.00	$187.00
	PV	$1,615.92	$1,615.92	$1,592.04	$1,592.04	$1,615.92	$1,592.04	$1,592.04
h) Incremental Reg. Pass. Serv. DOC (60% LF)	Annual	$4,989.74	$4,989.74	$4,916.00	$4,916.00	$4,989.74	$4,916.00	$4,916.00
	PV	$42,480.65	$42,480.65	$41,852.86	$41,852.86	$42,480.65	$41,852.86	$41,852.86
i) Incremental A/C Accident Costs								
Risk Level 0	Annual	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00
	PV	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96
Risk Level 1 (1.5X)	Annual	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00
	PV	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88
Risk Level 2 (2X)	Annual	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00
	PV	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80
Risk Level 3 (3X)	Annual	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00
	PV	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63

j) Mobile Equipment Replacement								
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 400)								
a) Emergency Health Care								
-lives saved (0.74/yr)	Annual	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00
	PV	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41
-permanent disabilities	Annual	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00
prevented (1.48/yr)	PV	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39
-temp disability-lost	Annual	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00
work days saved (23.2/yr)	PV	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41
b) Air Service User Time	Annual	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00
Savings (5,024 hrs/yr)	PV	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69

c) Employment (person-yrs)

-long term (annual)	-local	1.8						
	-rest of Manitoba	0						
	-rest of Canada	0						
	-total	1.8						
-short term direct:								
civil works	-local	4.62	4.54	4.99	5.20	9.26	13.66	6.23
	-rest of Manitoba	4.62	4.54	4.99	5.20	9.26	13.66	6.23
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	9.25	9.08	9.99	10.40	18.52	27.32	12.45
ATB	-local	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba	0.17	0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	0.20	0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local	0.58	0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba	0.59	0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	1.17	1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local	0.46	0.47	0.46	0.46	0.47	0.46	0.46
	-rest of Manitoba	2.03	2.04	2.02	2.02	2.04	2.02	2.02
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	2.50	2.51	2.48	2.48	2.51	2.48	2.48
SUBTOTAL	-local	5.70	5.62	6.07	6.27	10.34	14.73	7.30
	-rest of Manitoba	7.41	7.34	7.77	7.98	12.06	16.44	9.00
	-rest of Canada	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-total	13.11	12.96	13.84	14.25	22.40	31.17	16.30

-short term indirect:								
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	3.97	3.90	4.31	4.49	7.99	11.84	5.38
	-rest of Canada	4.16	4.08	4.51	4.70	8.36	12.39	5.63
	-total	8.13	7.99	8.82	9.18	16.35	24.23	11.00
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.06	0.06	0.06	0.06	0.06	0.06	0.06
	-rest of Canada	0.02	0.02	0.02	0.02	0.02	0.02	0.02
	-total	0.08	0.09	0.08	0.08	0.08	0.08	0.08
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	4.42	4.35	4.75	4.93	8.44	12.28	5.82
	-rest of Canada	4.32	4.24	4.67	4.85	8.52	12.54	5.78
	-total	8.73	8.59	9.42	9.79	16.96	24.83	11.60
TOTAL SHORT TERM	-local	5.70	5.62	6.07	6.27	10.34	14.73	7.30
	-rest of Manitoba	11.83	11.69	12.53	12.91	20.50	28.72	14.82
	-rest of Canada	4.32	4.24	4.67	4.85	8.52	12.54	5.78
	-total	21.85	21.55	23.26	24.03	39.35	56.00	27.90
TOTAL PV INCREMENTAL COSTS								
- Risk Level 0		$1,928,286.89	$1,912,695.33	$1,955,600.61	$1,994,675.94	$2,811,328.08	$4,511,021.94	$2,190,052.60
- Risk Level 1		$1,936,059.81	$1,920,468.25	$1,963,373.52	$2,002,448.86	$2,819,101.00	$4,518,794.86	$2,197,825.52
- Risk Level 2		$1,943,832.72	$1,928,241.16	$1,971,146.44	$2,010,221.77	$2,826,873.92	$4,526,567.77	$2,205,598.43
- Risk Level 3		$1,959,378.56	$1,943,787.00	$1,986,692.27	$2,025,767.61	$2,842,419.75	$4,542,113.61	$2,221,144.27
TOTAL PV INCREMENTAL BENEFITS		$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90
PVB/PVC (INCREMENTAL)								
- Risk Level 0		1.29869	1.30928	1.28055	1.25547	0.89077	0.55514	1.14347
- Risk Level 1		1.29348	1.30398	1.27548	1.25059	0.88832	0.55419	1.13942
- Risk Level 2		1.28831	1.29872	1.27045	1.24576	0.88587	0.55323	1.13541
- Risk Level 3		1.27808	1.28834	1.26051	1.23620	0.88103	0.55134	1.12746

TABLE G.22

RECOMMENDED STANDARD - 1200 ft RUNWAY

SUMMARY OF COSTS AND BENEFITS

(non-instrument runway)

a) CIVIL WORKS

			PAVEMENT TYPE (F)				
	Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
unit cost/sq.m.	$3.50	$3.00	$5.50	$6.50	$26.00	$71.00	$11.50
1. Access Rd (2000m long)	$130,250.00	$127,500.00	$141,250.00	$146,750.00	$254,000.00	$501,500.00	$174,250.00
2. Car Park (5 cars)	$1,200.00	$1,150.00	$1,400.00	$1,500.00	$3,450.00	$7,950.00	$2,000.00
3. Aircraft Apron (2 Twin Otter A/C)	$18,587.50	$17,875.00	$21,437.50	$22,862.50	$50,650.00	$114,775.00	$29,987.50
4. Taxiway (taxiway width = 7.5 m.) (taxiway length = 40 m.)	$3,600.00	$3,450.00	$4,200.00	$4,500.00	$10,350.00	$23,850.00	$6,000.00
5. Runway (non-instrument)	$244,578.89	$242,612.76	$252,443.41	$256,375.67	$333,054.74	$510,006.44	$276,036.97
Subtotals	$398,216.39	$392,587.76	$420,730.91	$431,988.17	$651,504.74	$1,158,081.44	$488,274.47

(strip length = 426 m.)

(graded area width = 38 m.)

(runway pavement width = 15.2 m. max to 7.6 m. min)

(runway pavement length = 366 m.);gravel= 366 ; turf= 366

Civil works Subtotals:		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat	Geoweb
	1+2 :	$131,450.00	$128,650.00	$142,650.00	$148,250.00	$257,450.00	$509,450.00	$176,250.00
	3+4+5 :	$266,766.39	$263,937.76	$278,080.91	$283,738.17	$394,054.74	$648,631.44	$312,024.47

b) AIR TERMINAL BUILDING AND RELATED UTILITIES

	Cost
Air Terminal Building	$16,000.00
Water Supply	$5,800.00
Sewage Disposal	$1,600.00
Power Generation	$30,000.00
Communications	$6,600.00
Subtotal	$60,000.00

c) EQUIPMENT

Equipment	Cost	Useful Life
Pick-up truck	15000	5 yr.
5 ton truck	40000	10 yr.
Tractor - loader	60000	10 yr.
attachments	25000	10 yr.
Subtotal	140000	

d)

LIGHTING AND NAVIGATIONAL AIDS

	Cost
Rotating Beacon	$4,000.00
Edge Lighting	$16,633.00
Apron Lighting	$2,800.00
Illuminated Wind Indicator	$1,800.00
Runway End Identification Lighting (REIL) (one runway end)	$13,600.00
Precision Approach Path Indicator (PAPI) one runway end	$33,400.00
Nondirectional Beacon (NDB)	$9,000.00
Subtotal	$81,233.00

Grand Totals	$679,449.39	$673,820.76	$701,963.91	$713,221.17	$932,737.74	$1,439,314.44

		Gravel	Aggregate-turf	Portland Cement Soil Cement	Soil Bitumen Soil Cement	Screen-Stone Paving Block	Aluminium Landing Mat
e) Resurfacing		(10 yrs)	(10 yrs)	(15 yrs)	(15 yrs)	(10 yrs)	(15 yrs)
	Constant $	$7,950.84	$8,037.16	$11,796.78	$11,796.78	$7,950.84	$0.00
	PV	$3,065.37	$3,098.65	$1,656.22	$1,656.22	$3,065.37	$0.00
f) O $ M	Annual	$45,000.00	$45,000.00	$40,000.00	$40,000.00	$45,000.00	$40,000.00
	PV	$383,112.00	$383,112.00	$340,544.00	$340,544.00	$383,112.00	$340,544.00
g) Incremental A/C Emerg. Serv. DOC	Annual	$189.81	$189.81	$187.00	$187.00	$189.81	$187.00
	PV	$1,615.92	$1,615.92	$1,592.04	$1,592.04	$1,615.92	$1,592.04
h) Incremental Reg. Pass. Serv. DOC (60% LF)	Annual	$3,731.14	$3,731.14	$3,676.00	$3,676.00	$3,731.14	$3,676.00
	PV	$31,765.43	$31,765.43	$31,295.99	$31,295.99	$31,765.43	$31,295.99
i) Incremental A/C Accident Costs							
Risk Level 0	Annual	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00	$5,218.00
	PV	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96	$44,423.96
Risk Level 1 (1.5X)	Annual	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00	$6,131.00
	PV	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88	$52,196.88
Risk Level 2 (2X)	Annual	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00	$7,044.00
	PV	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80	$59,969.80
Risk Level 3 (3X)	Annual	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00	$8,870.00
	PV	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63	$75,515.63

j) Mobile Equipment Replacement							
-pickup truck	Constant $	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00	$15,000.00
(5 yrs.)	PV	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33	$18,810.33
-5 ton truck	Constant $	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00	$40,000.00
(10 yrs.)	PV	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60	$15,421.60
-tractor-loader	Constant $	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00	$60,000.00
(10 yrs.)	PV	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40	$23,132.40
-attachments	Constant $	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00	$25,000.00
(10 yrs.)	PV	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50	$9,638.50
INCREMENTAL BENEFIT SUMMARY (Community pop = 400)							
a) Emergency Health Care							
-lives saved (0.74/yr)	Annual	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00	$175,949.00
	PV	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41	$1,497,959.41
-permanent disabilities	Annual	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00	$68,301.00
prevented (1.48/yr)	PV	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39	$581,487.39
-temp disability-lost	Annual	$324.00	$324.00	$324.00	$324.00	$324.00	$324.00
work days saved (23.3/yr)	PV	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41	$2,758.41
b) Air Service User Time	Annual	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00	$49,573.00
Savings (5,024 hrs/yr)	PV	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69	$422,044.69

c) Employment (person-yrs)

-long term (annual)	-local	1.8						
	-rest of Manitoba	0						
	-rest of Canada	0						
	-total	1.8						
-short term direct:								
civil works	-local		2.11	2.08	2.22	2.28	3.44	2.90
	-rest of Manitoba		2.11	2.08	2.22	2.28	3.44	2.90
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00
	-total		4.21	4.15	4.44	4.55	6.87	5.80
ATB	-local		0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Manitoba		0.17	0.17	0.17	0.17	0.17	0.17
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00
	-total		0.20	0.20	0.20	0.20	0.20	0.20
utilities	-local		0.58	0.58	0.58	0.58	0.58	0.58
	-rest of Manitoba		0.59	0.59	0.59	0.59	0.59	0.59
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.17	1.17	1.17	1.17	1.17	1.17
navaids	-local		0.38	0.38	0.38	0.38	0.38	0.38
	-rest of Manitoba		1.61	1.62	1.60	1.60	1.62	1.60
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00
	-total		1.99	2.00	1.98	1.98	2.00	1.98
SUBTOTAL	-local		3.10	3.07	3.20	3.26	4.43	3.89
	-rest of Manitoba		4.47	4.45	4.57	4.63	5.81	5.26
	-rest of Canada		0.00	0.00	0.00	0.00	0.00	0.00
	-total		7.57	7.52	7.78	7.90	10.24	9.14

-short term indirect:							
civil works	-local	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	1.81	1.79	1.91	1.97	2.96	2.51
	-rest of Canada	1.90	1.87	2.00	2.06	3.10	2.63
	-total	3.71	3.65	3.92	4.02	6.07	5.14
ATB	-local	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.10	0.10	0.10	0.10	0.10	0.10
	-rest of Canada	0.03	0.03	0.03	0.03	0.03	0.03
	-total	0.13	0.13	0.13	0.13	0.13	0.13
utilities	-local	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.29	0.29	0.29	0.29	0.29	0.29
	-rest of Canada	0.10	0.10	0.10	0.10	0.10	0.10
	-total	0.39	0.39	0.39	0.39	0.39	0.39
navaids	-local	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	0.03	0.03	0.03	0.03	0.03	0.03
	-rest of Canada	0.01	0.01	0.01	0.01	0.01	0.01
	-total	0.05	0.05	0.05	0.05	0.05	0.05
SUBTOTAL	-local	0.00	0.00	0.00	0.00	0.00	0.00
	-rest of Manitoba	2.23	2.20	2.33	2.38	3.38	2.93
	-rest of Canada	2.04	2.02	2.15	2.20	3.25	2.78
	-total	4.27	4.22	4.48	4.59	6.63	5.71
TOTAL SHORT TERM	-local	3.10	3.07	3.20	3.26	4.43	3.89
	-rest of Manitoba	6.70	6.66	6.91	7.02	9.20	8.19
	-rest of Canada	2.04	2.02	2.15	2.20	3.25	2.78
	-total	11.84	11.74	12.26	12.48	16.87	14.85
TOTAL PV INCREMENTAL COSTS							
- Risk Level 0		$1,210,434.91	$1,204,839.56	$1,188,478.96	$1,199,736.22	$1,463,723.26	$1,924,173.27
- Risk Level 1		$1,218,207.83	$1,212,612.48	$1,196,251.88	$1,207,509.14	$1,471,496.18	$1,931,946.19
- Risk Level 2		$1,225,980.74	$1,220,385.39	$1,204,024.79	$1,215,282.05	$1,479,269.09	$1,939,719.11
- Risk Level 3		$1,241,526.58	$1,235,931.23	$1,219,570.63	$1,230,827.89	$1,494,814.93	$1,955,264.94
TOTAL PV INCREMENTAL BENEFITS		$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90	$2,504,249.90
PVB/PVC (INCREMENTAL)							
- Risk Level 0		2.06886	2.07849	2.10710	2.08733	1.71088	1.30147
- Risk Level 1		2.05568	2.06517	2.09341	2.07390	1.70184	1.29623
- Risk Level 2		2.04265	2.05202	2.07990	2.06063	1.69290	1.29104
- Risk Level 3		2.01707	2.02620	2.05339	2.03461	1.67529	1.28077